WORK

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FOR ALL WORKMEN, PROFESSIONAL AND AMATEUR.

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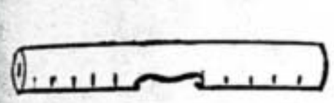

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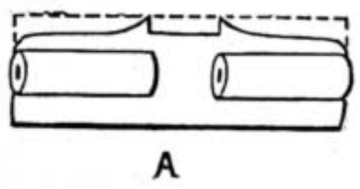

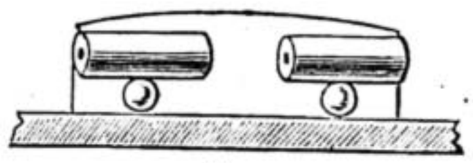

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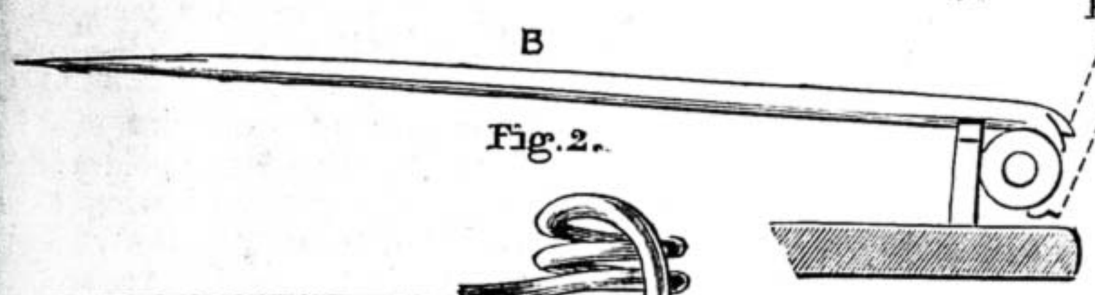

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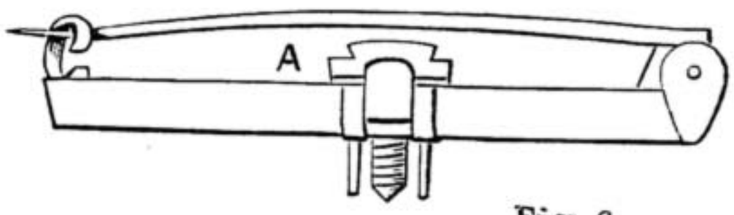

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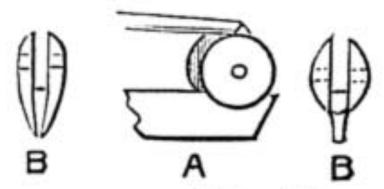

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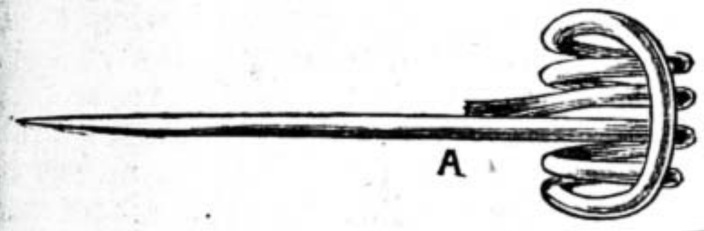

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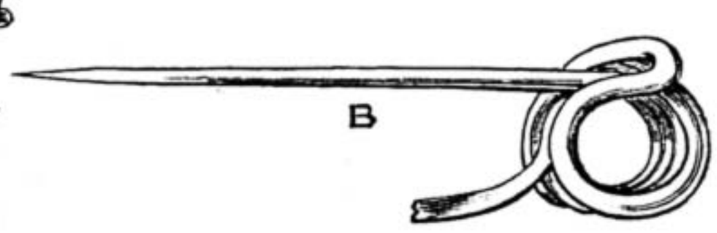

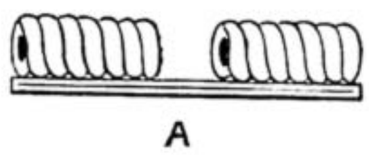

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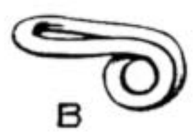

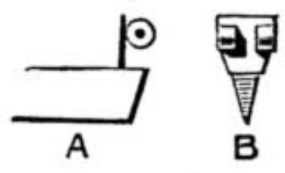

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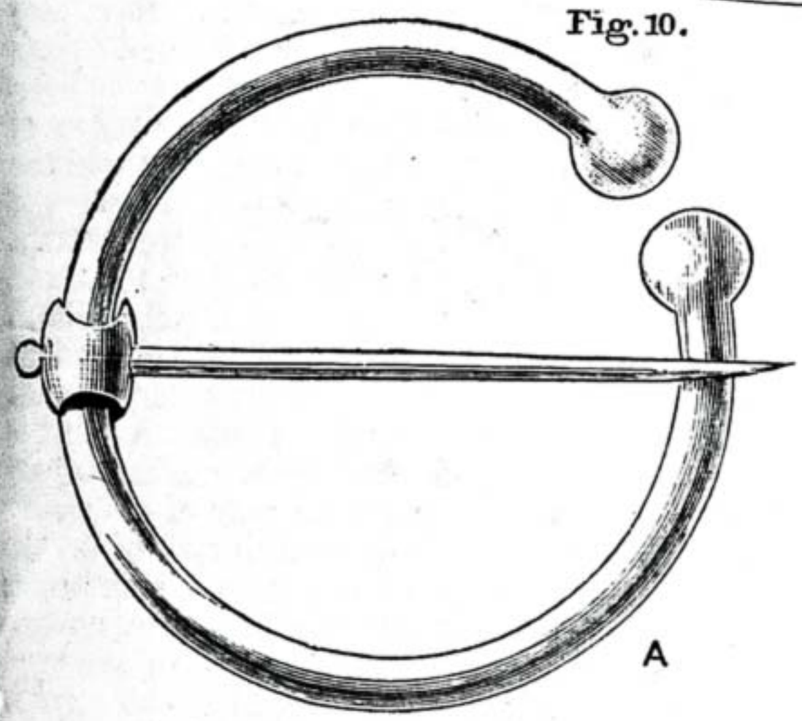

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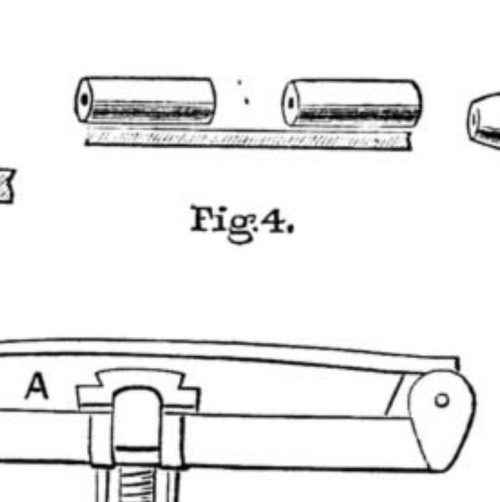
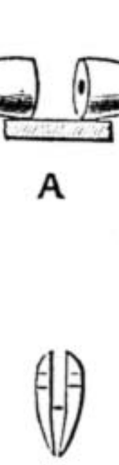
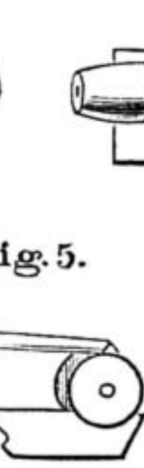






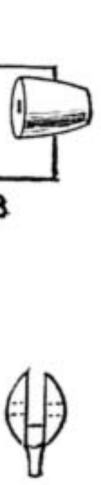
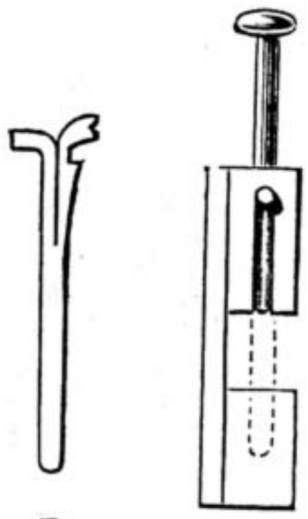


Fig. 12. Fig. 13. Fig. 14.

Fig. 15.

Fig. 16.

Fig. 17.



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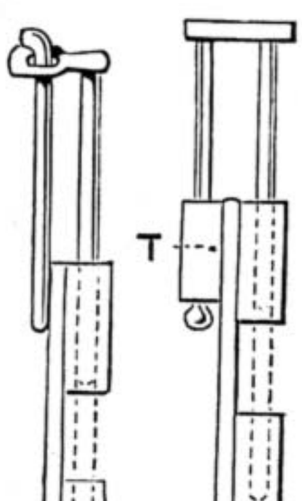

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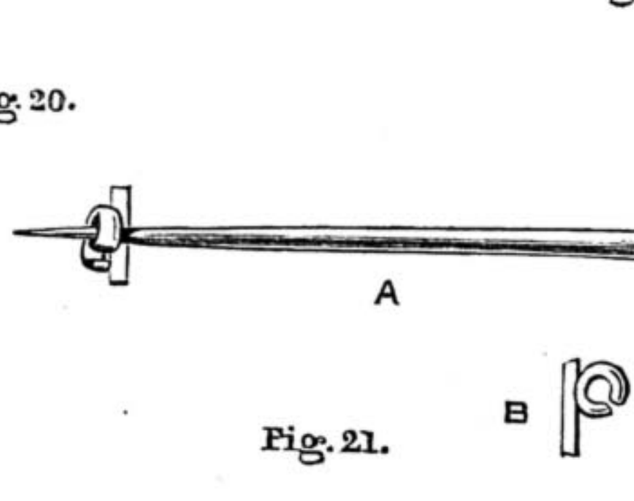

Fig. 20.

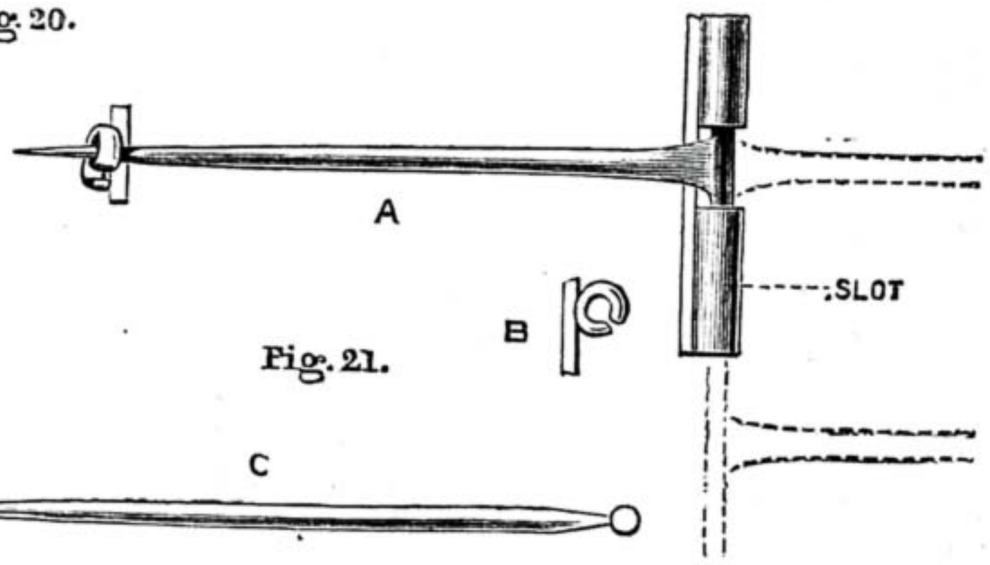

Fig. 21.

BROOCH JOINTS. Fig. 1.—Piece of Joint Chenier prepared for soldering on. Fig. 2.—A, Chenier soldered on and Centre Piece cut away ready to fit Tongue; B, Height Joint should be raised; also by Dotted Lines Convenient Distance for Tongue to turn back. Fig. 3.—Method of supporting Side Knuckles by Grain of Gold; B, ditto by means of Bar. Fig. 4.—Joint without Fly-up Plate. Fig. 5.—French or Barleycorn Joint. Fig. 6.—A, Side View of Ball-Joint made from Flat Plates, a Strong Form of Narrow Joint; B, End View of same. Fig. 7.—Ditto, but made from Grain of Gold with Centre cut away; B, End View. Fig. 8.—Weak and Bad Form of Narrow Joint—A, Side View; B, End View. Fig. 9.—A, Etruscan Joint formed from Coiled and Soldered Wire; B, Another Form of ditto formed from Wire. Fig. 10.—A, Top View of Antique Brooch Joint in British Museum; B, Side View of same. Fig. 11.—A, Type of Celtic Brooch-fastening without Catch; B, Showing by Solid Lines the Position for Insertion, and by Dotted Lines the First Move towards Fastening, *i.e.*, Point between the Ends; C, Position of Tongue when fastened: the Rod, R R, indicates way Material acts in securing Brooch. Figs. 12, 13, 14.—Joint with Simple Removable Joint-Pins. Fig. 15.—Joint with Pin that allows of Partial withdrawal. Fig. 16.—A, Section of Joint to take B, a Screw Joint-Pin. Fig. 17.—A, Section of Joint to take B, a Spring Joint-Pin. Fig. 18.—Another Form of Joint where Pin can only be partly withdrawn. Fig. 19.—Another Form of Joint acting on a Guiding-Bar. Fig. 20.—Another Form of Joint acting through a Tube. Fig. 21.—General View of Removable Tongue in Position: Dotted Lines show course of Removal or Insertion; A, Shows Position of Slot: B, Side View of Open (Lower) Knuckles; C, Side View of Tongue showing how it is thinned down to pass along Slot where soldered to the Joint-Pin.

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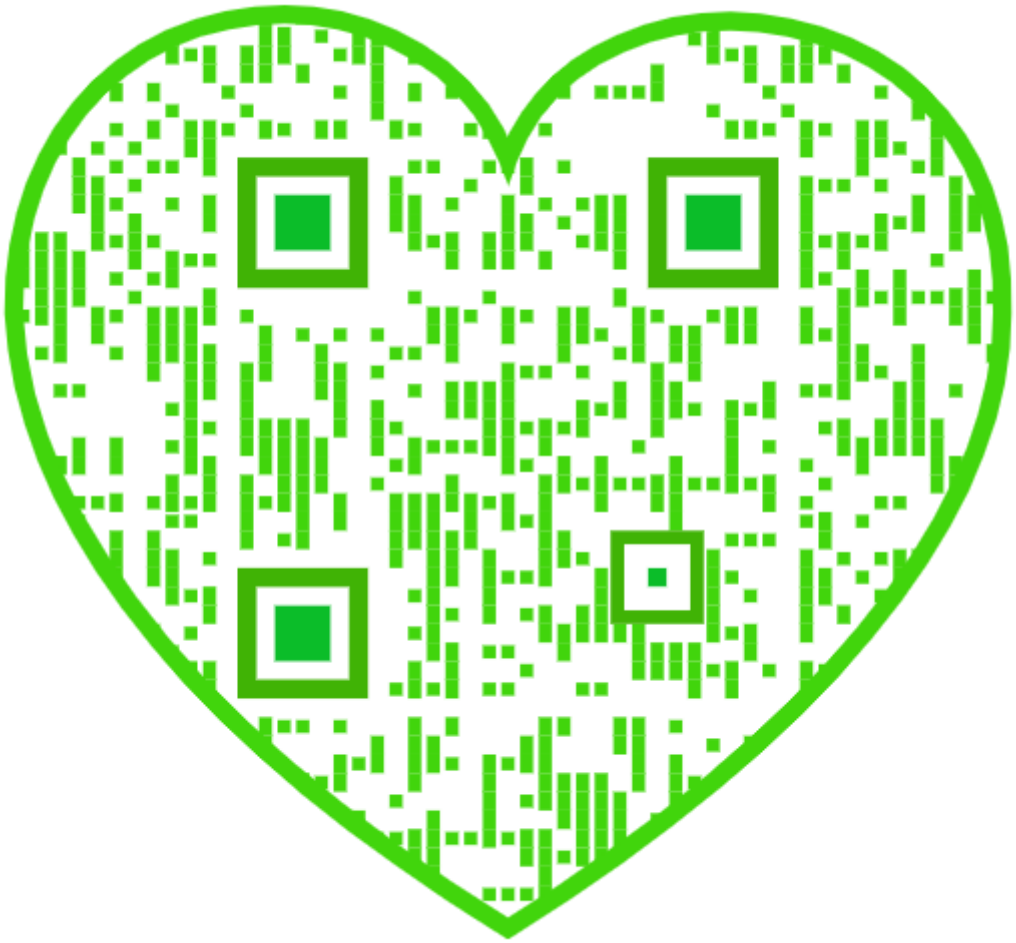

THE BROOCH: HOW TO MAKE IT.

BY H. S. GOLDSMITH.

THE JOINTS OF BROOCHES.

THE joints of brooches are so evidently the next in order to tongues of brooches, that no reasons are wanted to explain the why and the wherefore of this paper coming next.

We shall have to see that they are made strong enough for a fair amount of wear, and that they are suitable to the size of the brooch, and in keeping with the character of the ornament.

We will first take up the most common form: *viz.*, those with the fly-up plate soldered to the joint for the tongue to obtain its spring from, for which tongues such as Fig. 5, A to D, in the previous paper, are suitable. Then those without the fly-up plate, for which the tongues, E, F, and G, are used.

Finally, the form of joint where the tongue is removable at pleasure.

Before we begin this matter, I particularly wish to call attention to the possible results of an unsoldered joint. It may cause a great amount of trouble and expense if it be not noticed before the work is finished, for I know—and if you do not know now, you will later on, to your own cost, too, I hope—that to reset and to polish and colour work a second time is running a great risk of the work not finishing, besides the loss of time and the delay in the delivery of the work to the customer, all of which can be prevented by a little care and attention on the part of the workman.

Now, to make the joint of a brooch we want a piece of chenier of suitable length and thickness, from the centre of which a portion has been cut away—of less than one-third in length, and only half-way through for the present, like Fig. 1. Then tie it on a plate of fair thickness, Fig. 2 A and B (I should say certainly not less than size 8; Shakespeare Guage 10 or 12 would be better), and solder it with the joining or soldering seam in actual contact with the plate, in order to get it firmly and soundly soldered: I mean so soldered that it cannot come open any more. The next thing to do is to remove the other half of the centre piece, and to fit the tongue in between these two knuckles or side pieces of the joint, and let it be fitted properly. If you want a pattern for your fitting, look at the hinge of the nearest door, and you will probably find that great affair fitted better than many tongues are, particularly in job work. Now, as our work is of a much finer and more delicate kind than that of a hinge maker, I trust that you will do your jointing as it should be done; it only wants a little care and practice—but it wants them both to turn out a properly made joint.

The other way of making a joint, by soldering each knuckle on separately, is rarely used for single brooches, and as that method more properly belongs to the joints of lockets and boxes, we will deal with that when we come to those particular articles.

We have now to solder the joint on to the brooch. But how? Some jewellers have the chenier fitting close down on to the brooch and soldered to it; but I prefer slightly raising it, as Fig. 2 A and B, Fig. 3 A and B, in order to let the tongue come back rather more than a right angle, which we cannot do without weakening the tongue, if the chenier be soldered close to the back of the brooch. Fig. 2 gives about the proportion of height required, and the dotted lines show the distance or angle to which the tongue should be able to move. If you raise the joint as advised, and you have made your fly-up plate too weak, you will have to support the side knuckles with grains, like Fig. 3 A, or a bar, like Fig. 3 B; but you ought not to require either.

You will, of course, file up the fly-up plate—something like Fig. 2 A or Fig. 3 A will do, or any other shape that you may prefer, providing that it is not liable to catch in lace that a lady might wish to wear with it.

We will suppose that the joint is soldered in its place (I will tell you about the place later on, when I summarise the first three papers on tongues, joints, and catches), and the tongue fitted. Now we will regulate the hole with a joint-brooch, and from the proper end, if you please. I don't suppose half the trade have thought about there being a proper end to put a joint-pin in—well, there is; and it is from the top end, and this is why—if it works loose, then it will work upwards, and may be noticed and replaced, while if it works loose after being inserted at the lower knuckle first, it will naturally work downwards and drop out; then the brooch will fall away, and either get damaged or lost. I can tell you that it is but a week ago that my firm gained a most valuable customer through this very defect on another firm's part, by which a diamond brooch was nearly lost.

The joint-pin itself should be of hard wire (metal or gold-wire I mean, not hard steel); it should taper gradually, if at all, and be finished with a smooth file; it should bind on the two outside knuckles so as not to rotate when the tongue moves; it should also be tight enough to keep the tongue perfectly steady, and on no account to let it wobble up and down, and from side to side anyhow; in short, it should *fit*.

We may as well finish with the joint-pin here, although in practice it is the last thing we have to do before the work is sent home.

I have been taught that a joint-pin, if properly made and fitted, should stay in its place by itself, and it undoubtedly should in most cases; but with brooches I slightly rivet the ends of the joint-pin over—it gives so much extra security, and when carefully done, neither the brooch nor joint is touched or damaged. Mind, this riveting is in addition to a properly fitted joint-pin, and is not to be used in place of one fitted anyhow.

If the joint is not to have a fly-up plate, as Fig. 4 and Fig. 5 A, we prepare the chenier in the same way as before—that is, with part cut away from the centre—and proceed to solder it on the back of the brooch, or on a plate like Fig. 4 and Fig. 5 A; then we cut the remaining half of centre away as before, and fit the tongue. The tongues for this class of joint have to be made like Fig. 5, E, F, and G, in the previous paper, in order to obtain the requisite spring, which in the previous case we got from the fly-up plate.

The diagrams, Figs. 5, 6, 7, 8 and 9, give a few different forms of these classes; there is the Barleycorn, Fig. 5 A and B, made from thick chenier, and is filed into the shape it has. It is mostly used on French jewellery.

The ball-joint, Fig. 6 and Fig. 7, is the form usually found in the fittings for diamond work. It is either made from two pieces of thick gold, like Fig. 6 A and B, or else a grain of gold is melted, and the centre is cut out on Fig. 7 A and B, to take the tongue—which in these cases is formed with a flat plate instead of chenier—and the whole is drilled through together to take the joint-pin. Either way, we get an improvement on Fig. 8 A and B, with its weak knuckles; but Fig. 6 is decidedly the better of the two, inasmuch as each knuckle can be well and securely soldered to the side of the brooch mount.

Fig. 9 A is a joint whose chenier is made out of a coil of rings soldered together; it is sometimes called Etruscan.

It is undoubtedly one of the best, if not the very best, we can have—there is no danger of a soldering seam opening here, for the excellent reason that there is none to open. This is even stronger than the chenier without a soldering seam that has been introduced into the trade, for that might split if there were a flaw in the gold, while all the flaws would have shown themselves in drawing down the wire, and have caused it to break where they were, long before we had reduced our wire to the small size required for this work.

Fig. 9 B is another form of joint, used in the modern Etruscan or Roman gold work; it is made from one piece of wire, as I think the diagram clearly shows. One tongue for this is Fig 5 K, in the paper that precedes this. Generally a piece of tube takes the place of the joint-pin, and it is chamfered or burred over, so there is no fear of that dropping the tongue out. It is also worth noting as one of the narrow and strong class of joints.

The coiled wire that takes the place of a joint in a safety-pin brooch is much the same in all of them, except that we get three turns instead of two occasionally. You will see, by referring to Fig. 10 A and B, and Fig. 6 in the paper on Catches (both Fig. 6 and Fig. 10 being drawings of ancient brooches now in the British Museum), that this method of doing away with a joint is not in any way a new idea. Fig. 10 particularly has a very clever way of obtaining the spring, with the minimum risk of breaking the tongue short off, which sometimes happens to the safety-pin brooches, now so much worn. In this case, and in the type of brooch indicated by Fig. 11, no attempt is made to hide the means of fastening, as we always do, nowadays: in fact, the aim of these ancient jewellers undoubtedly was to turn a necessary part of the construction into an ornament, which is, I am told, the artistic way—and it can hardly be disputed, either—in these two cases, at any rate.

Do my young readers know how Fig. 11 is fastened? for it has no catch, as we generally understand the word, and the joint into which the tongue is soldered travels easily round the rim from end to end. What prevents it falling out? you may reasonably ask. The answer is the shawl, or whatever it fastens. That looks like a bull—and as this type of brooch chiefly comes from Ireland, a bull is surely admissible here, if at all—but it is a fact, nevertheless. First we will put the tongue through the shawl, etc., Fig. 11 B; then place the point between the ends shown by dotted lines, and bring it on to the top or front of the rim, like Fig. 11 A and C, and slide it round a little way, or a long way, just as you like, and that is all. We shall find that the shawl, etc., is acting in the way shown in the diagram, Fig. 11 C, by the rod, R R; and it is a good secure hold too, but it is only suitable for large brooches that have to fasten shawls and plaids, or such-like heavy woollen articles.

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We will now have a few words on joints that allow of the temporary removal of the tongue, for this is often required in valuable ornaments that have to do duty for several articles, forming either brooch, pendant, or locket, bracelet-centre, hair-pin, etc., at the pleasure of the owner. Of course, joints and catches are made to remove altogether; however, at this early stage of my papers I do not think I will go into details, but will do so when I come to the fittings for diamond work, about which there will be plenty to say, and to illustrate.

In the meantime here are a few methods of getting rid of the sharp tongue, for no lady in evening dress could wear an ornament as a pendant, and have the point continually scratching her. And if the point were covered up by a protective catch, after the manner of Italian mounts for Mosaic work, there still remains all the brooch fittings to prevent the pendant or locket resting steadily and close to the figure; besides, as it is not wanted it is best away, so take your choice of doing it from what follows, or evolve something yourself which will be better practice for you, only using these as hints.

The simplest way of all is by making the joint-pin to take in and out; so just solder a top on like Fig. 12 or Fig. 13, and do not forget all these easily-fitting pins are to be inserted from the *top* end of the joint.

Fig. 14 is a split joint-pin, made out of two half-round pieces of wire soldered together at the two ends; this can be made to spring apart just a little, and so give some sort of a hold.

Fig. 15 is much the same, but it has a peg inserted and soldered to the knuckle; this allows of only the partial withdrawal of the joint-pin, and prevents its loss. It is a way much used to fasten Indian bracelets, for which it is much more suitable, as the size chenier required would look clumsy on a brooch; but as it can be used sometimes, I give it here.

Fig. 16 A has the top knuckle enlarged, and a plate or ring soldered in to take a screw. The joint-pin, Fig. 16 B, is made like the sketch, and generally with a fall-down handle, but that will have to be governed by circumstances; it has got to be unscrewed by the fingers, so take whatever means you best can to facilitate that.

Fig. 17 A and B is a spring in place of a screw, and there are doubtless many other ways that an ingenious workman will devise to obtain a desired result; and speaking for myself, there is nothing I like better than some good tough proposition in jewellery mechanics to work out.

These entirely withdrawing and removable joint-pins are always getting mislaid or lost, so I will follow on with one or two methods of retaining the joint-pin in its place.

Fig. 18 has a slot cut in the top knuckle, in which a peg can work up and down, and to the peg the joint-pin is soldered; it should not be made to withdraw further than to allow of the tongue's removal.

Fig. 19 has the joint-pin soldered to a cap, and the cap is pierced and fitted to run on a parallel guiding-bar, or else with the bar soldered parallel to the joint-pin and working through a tube (T), Fig. 20, soldered underneath the joint or behind, or wherever is most suitable for your particular job.

In the paper on Catches, which will follow this, you will find particulars of a fall-down catch that should be used with these removable tongues. Fig. 7 is its number.

Thus far only the withdrawal of the joint-pin to allow of the removal of the tongue has been considered, and for that purpose all has been worked from the top knuckle, so that if by accident or wear the joint-pin becomes loose, it will not drop down and disengage the tongue. Now, our next example, Fig. 21, is one in which the bottom knuckle plays a part, and for the same reason: namely, that it is the more secure of the two for the purpose.

This bottom knuckle has a slot cut right through it in the position indicated in Fig. 21 B.

The joint-pin is here soldered *to* the tongue, which is flattened and broadened out (Fig. 21 A and C); it is placed in position sliding along the slot, as indicated by the dotted lines; then when the tongue arrives in between the knuckles, it is turned down towards the catch in the usual way.

This is the one I mostly use, as it makes a neater joint, and reduces the number of pieces that have to be made and fitted, but it has two very important parts that want watching: first, the soldered connection of the joint-pin and tongue, which must be sound, and yet leave the round joint-pin quite clear where it joins the tongue, Fig. 21 C; the second point is the slot, which must be just wide enough to allow the joint-pin to come out sideways. I have enlarged all the diagrams on purpose to make things clear, and I hope I have succeeded.

This brings me to a finish of this paper; and before entirely closing it, I should like to say that all I have written here are what I have made or have seen, so there is nothing theoretical about them; but I must warn anybody that tries their hand at the more difficult ones, that patience, care, and skill will be required to carry them out properly, and even then it seems that it is not every man who is able to make them.

They should be taken in hand with a thorough intention to do the very best, and if done with a little thought, I do not fear the result.

As all of them depend on exactness of fitting, it is evidently of no use rushing at them in a careless, anyhow sort of way—slogging may do at cricket, but it won't do at jewellery. And if we aspire to be in the front rank of our trade, we must do all our work conscientiously, and I had almost written devotedly.

This capability of taking infinite pains, which somebody says is the sign of genius, will at the end give the requisite skill if intelligent practice is added; please notice that I have not written practice only, but practice and intelligence added, for practice (I mean making many things of the same sort) never will *alone* make a good workman. To become that depends to a very great extent indeed—in fact, almost entirely—on the man himself, and I hope that such a one may find a little now and then in these papers to help him on his upward road.

PLAIN AND DECORATIVE HOUSE PAINTING.

BY A LONDON DECORATOR.

Mixing Oil Paints and Compounding Tints and Shades of Colours for Practical Use—Second and Third Coats.

Let us now give a glance around the room before I make up the paint, and get some idea of what is required. We notice that, beyond the discoloration of the white plaster cornice, there is little evidence of oil paint on its surface, so that the oil has all been absorbed into it. The walls, however, having been well trowelled and finished, show some signs of the glossy paint on the surface, hence the suction is entirely stopped in those places, and, probably, nearly so all over. Under these circumstances, the previous kind of paint, but with a little more lead in it, is required for the second coat for the cornice, but, for the walls, I make it up considerably rounder, or thicker, and use, instead of all oil, two parts of linseed to one of turps.

Before straining this, I add sufficient Venetian red in oil to give my paint a decided pink cast, which not only enables us to see that nothing is missed, but also exerts an agreeable influence of colour upon the succeeding coats.

My second coat to cornice and walls being now manipulated as before, I return to the woodwork. Having lightly papered it down, I dust it, and stop the nail-holes in the panel mouldings, etc., with putty made from white lead stiffened up with best, or gilders', whiting. After stopping woodwork, it is advisable to let it stand a day, to enable the putty to harden on the surface; the second coat of paint can then be applied without affecting it, and should be of similar proportions to that last spread on walls, but in this case I use the paint without any stainer. We have now two coats upon all our work, the absorption in cornice, wall, and woodwork being thereby effectually stopped. Before, however, we consider the finishing *colour* of our paint work, we must turn our attention to the ceiling. This is now coated with a preparation of size and whiting, with the object of stopping some of the suction of its surface; and, having again become thoroughly dry, I finish my ceiling-light with three coats of white paint, and the flat, or bed, with a coat of faint pink distemper—a lesson on which process I postpone until the present one is completed.

At this point it is now necessary that you, my reader, as the supposed patron as well as learner, and I, the practical worker and adviser, should consult together as to the finish and appearance of our temporary job. May be you have received instructions from the partner of your joys and sorrows (who, probably, paints upon banjoes, tambourines, drain-pipes, etc., for the embellishment of your drawing-room, and is a member of the "Blankport Amateur Sketching Society") that such and such a "fashionable" shade of "electric" blue or peacock green will give the most artistic effect; or, perhaps, you have some striking colour-notion of your own, originating from a profound study of the charming kaleidoscope of colour obtained with a pot of Mr. Aspinall's enamel. This decision, we will suppose, is eventually arrived at—that the teacher's knowledge and experience shall be responsible for the artistic as well as the practical success of the work, the "why and wherefore" of my selection of colour being explained as we proceed.

In spreading a succession of coats of oil paint, upon plaster work especially, it is not advisable to use two coats of *all oil* colour upon each other, unless for the purpose of stopping the absorption; when, however, that end is gained, it is necessary to use the next coat with a larger proportion of turpentine than oil. If we continue using our paint very oily, each coat hardens, so to speak, in itself; but if we interpose sharp or turps colour between two coats of oil paint, the former acts as a cement, and the

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three coatings become firmly bound together. In *flatting*, or dead-painting, surfaces, this same principle underlies the whole process. A last coat of oily paint, nearly identical in colour to the desired tint of flatting, is very carefully spread, and upon this *ground*, as it is technically termed, the thin coating of purely turps colour is laid before the ground becomes properly hard—which is generally the next day or next but one. Providing the ground and flatting are properly prepared and manipulated, we find this action takes place: the oil of turpentine slightly opens the surface of the linseed oil ground beneath it, so that the latter takes hold of the particles of pigment contained in the flatting, whilst the gradual evaporation of the turps leaves the surface without gloss, the pigment being held from beneath by the oil, but uncased with any upon the surface. Woodwork and walls, if properly flatted, can be washed as safely as can oily paint, but the same knowledge of its nature is as necessary to successfully clean and preserve it as it is to prepare it. It is only when wrongly manipulated that flatting will not stand fair wear and tear.

This explanation will now help you the better to follow my methods. Having determined to flat the cornice, I must previously ground it with oil paint, somewhat akin to my finishing, flatting, colour. The wall space we will leave in a medium gloss of oil paint, so that my third coat must be of sharp colour and near the tint of finishing paint. The cement skirting I shall now first coat with the paint used on walls, and then finish that and the woodwork with two more coats of good oil paint. I here remind you that this decision is made with a view to present economy and the temporary nature of the job; permanent embellishment is to come later on.

In painting a billiard-room particularly, the range of suitable colour is governed, and limited considerably, by the appearance of *the* principal article used therein, namely, the vivid green mass of the billiard-table covering and the accompanying green shades to the usual gas-lighting arrangement. If, therefore, our selection of colours is of a common sense nature, it must not clash with or in the least detract from the appearance of the billiard table. The dominant colour-tone of a room is usually furnished by the walls, and being, here, the principal surface the eye will rest upon after leaving the green table, their appearance is a most important item.

Now every definite colour has its *contrast* and *complementary*: that is, a colour directly opposite it in appearance and sentiment; but which, when placed in juxtaposition therewith, not only improves and heightens the effect of it, but combines with the former in producing the sensation of *colour harmony*. In the selection of colour, *contrast* is therefore one scheme we may choose; the *alternative* in this case is to keep our walls more in *unison* of colour with the billiard table, namely, a subdued shade of green.

The complementary colour of the bright green in question is a rich purple red, the two combined giving a very brilliant appearance. Harmony of colour and brilliancy of contrast is not the principal object in this instance, however; my aim is rather to soften down the vivid green than to enhance its brightness, which any shade, however deep, of its complementary upon the walls would do. Our best wall colour will therefore be a dull and soft-toned green, and by introducing the warm complementary colours into cornice and woodwork we shall obtain pleasing and harmonious results.

From this short gossip on theory, we turn again to our practical operations. Preparing my third coating and ground first occupies our attention. The sharp wall colour is mixed—the proportions of lead and patent drier being twelve to one respectively—with nearly three-fourths of turps to the remaining part of linseed oil. There is no occasion to measure it out exactly, but if the solids are beat up in oil into thick batter consistency, it will require turps only for thinning it for use. I put enough of the thick paint aside as will suffice for the cornice, and before thinning the remainder for my walls, I stain it to warm green with the subjoined pigments, ground in oil: Prussian blue, yellow ochre, and burnt umber. In the colour mixing you manifest much interest, and since we feel the impossibility of adequately conveying, by signs or sounds, knowledge appertaining to the sense of colour only, I gladly bring to our aid the array contained on "Aspinall's enamel" card before mentioned.

I will here strongly advise all readers of WORK who take more than a passing interest in these papers to procure, if at all possible, one of the cards alluded to. Lessons on colour, without colour examples to work with, are of little avail; but with such a collection of some hundred different hues, tints, and shades of colour before both contributor and knowledge-seeking reader, the practical and artistic value of these papers should be increased tenfold.

To return to my wall paint, I find the exact shade is not contained on Aspinall's card, but its appearance is similar to "sage green" in colour, although of a much lighter tint. To ensure, however, a good solid wall when finished, I stain this "third coating" paint several shades *darker*, since a lighter, finishing shade of any one colour will cover much better when superimposed upon a darker shade than *vice versâ*—a point it is very necessary to remember in oil painting. In mixing both this and the finishing wall paint, I first stain the white to a medium blue, then add ochre and convert it into green, and lastly, the umber to soften and neutralise, or to warm the green mixture. Previous to spreading my "sharp," that is comparatively quick-drying wall paint, I must ground the cornice, but as I intend introducing thereon some warm tints in contrast to the "sage green" walls, it is best to first mix my finishing woodwork colours.

As some relief to the mass of wall colour, I determine to paint the woodwork in dark warm shades, and which, upon reference to the colour card, I find nearly identical to the globes thereon, marked, "Arabian brown" and "Terra-cotta, No. 3." The former, which is the darker of the two, I use upon the entire door frame and window frames, the doors, with the exception of panels and mouldings around same, and the deep bottom plinth of the skirting. The panels of the woodwork, the window-sashes and top plinth of skirting, I paint with "Terra-cotta, No. 3;" and, with a view to brightening up the doors in their entirety, I shall finish the panel mouldings and one member or division of the door frame with the soft sage green wall colour. From the method I proceed upon, there can be gathered the advantage of deciding and making-up the dominant colour given by the room, namely, the warm green, at the start, so that the remaining and contrasting colours may be compared therewith, and the most harmonious effect obtained. The paint for the woodwork I make from Venetian red and burnt umber chiefly, with the addition of a little ochre, lightened up with white for the panels and Indian red. In contrasting any shade of green against a warm colour, it should be remembered that the more yellow the green contains, it must be opposed by an equally blue or purple-toned red; the true contrast of *pure red* being, *not* as has been taught by some colourists, pure green, but a decidedly *blue hue* of *green*.

Notwithstanding the principles of colour-harmony are as definite as those which give us harmony of sound, a knowledge of the exact equivalents of a colour will not guarantee the successful colour-treatment of a room or building. The scientific equations alluded to should form the foundation of our colour-studies; but the amount of success we obtain will, however, depend upon our adaptation of these definite laws to each particular circumstance and undertaking. The climate and light, the position and interior lighting of the room, the scenery from the windows, are each and all prominent factors in determining the strength and weakness of the contrasting tints which compose a harmonious colour scheme—besides the more positive reasons I have explained herein—and it is then that scientific proportions fail the decorator, and he has to rely upon his own experience and faculty as a *colourist*.

Having given this explanation, you will agree that I cannot well describe to a novice the exact arrangement of my cornice colours. You notice, however, that I treat it in three main divisions: that portion next the wall I paint with a colour similar to the woodwork panels, but with the addition of a little more white and umber. The middle recessed division, or cove, I paint with a slightly more blue-grey and lighter tint of wall colour, made by adding a very little blue and white to the latter; whilst the third and top division of mouldings I ground a lighter and more golden hue of the base part. These cornice paints—which I have prepared from the "thick white" put aside previously for the purpose, and for staining or colouring which I have principally used a little of my woodwork and wall paints—are now well strained; and, being thinned with three parts oil and one of turps, are spread according to the above arrangement. The wall space being previously papered down, and any little indentations in the plaster faced up with the hard stopping made for woodwork, is now third-coated with the "soft" sage green, used darker than the desired finish and with fully two-thirds of turps to one of oil. The third coat requires to be rather rounder, thicker, than the two previous ones; must be well spread, laid off, and worked rather expeditiously, one flank or division of the wall at a time to avoid the joints "catching," as it is termed. The cement skirting is afterwards first-coated with the same colour spread *very barely*; and, as it is a comparatively non-absorbent surface, this sharp paint forms the best "key" for the dark red, finishing paint. Its present colour is no disadvantage, since the first coat of woodwork paint will effectually hide it.

I am again obliged to break off in my subject here, but I may add that few remarks are required to bring this part of my subject to a conclusion, and that they will be chiefly directed to the treatment of the cornice and flatting, and the colouring of the skirting and woodwork.

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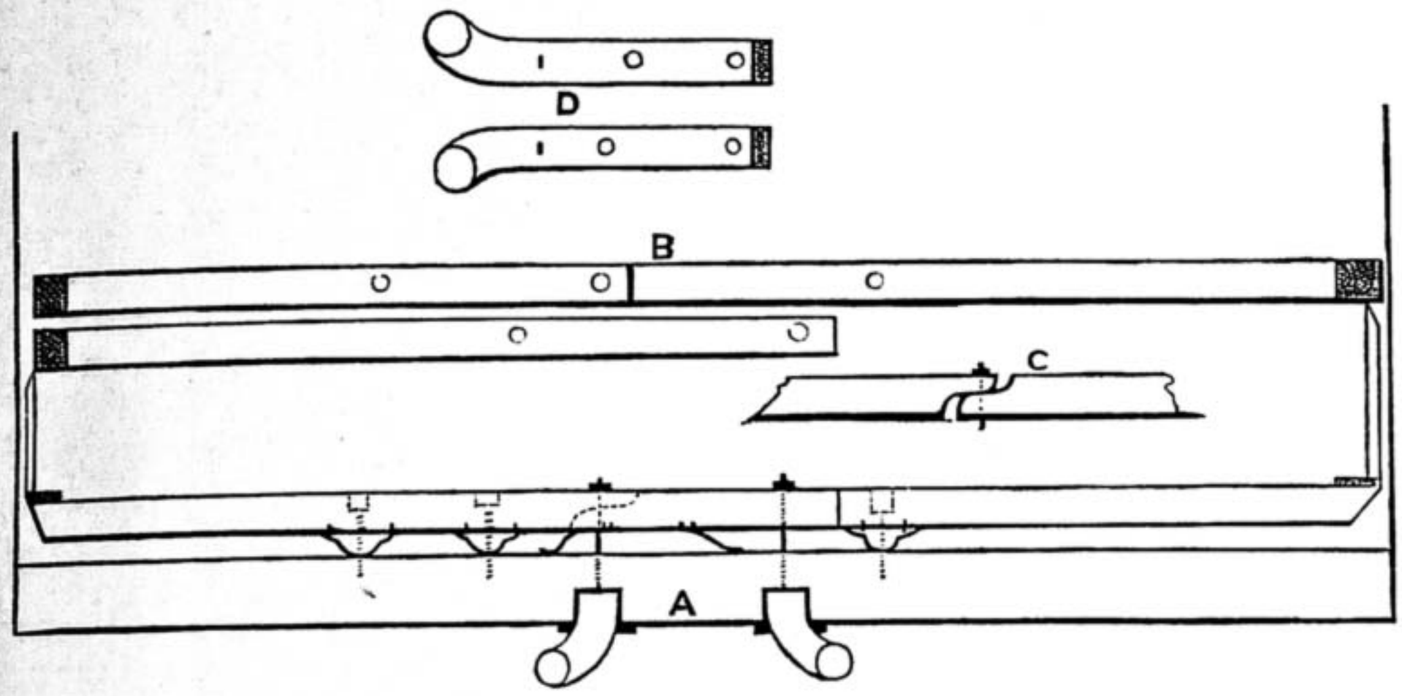
HOW TO MAKE A PIANO.

BY "NIL DESPERANDUM."

FINISHING OR FITTING INTERNAL MECHANISM—PEDAL ARRANGEMENT AND CELESTE PEDAL.

THE case having been completed, it is now ready to receive the internal mechanism, or action. This branch of the trade is known as the finishing. The finisher prepares the keys and action for the case, and adjusts the different parts so as to bring the whole into working order, including the pedal action. Formerly, the pianoforte manufacturers made their own small-work, or action and keyboards; but as the demand for pianos became greater, it was found necessary to make more divisions in the labour to facilitate production. This made room for the key maker and action maker to supply the manufacturers, thus making the key maker and action maker two distinct trades. Although I am aware there are a few firms who make their actions and keyboards on the premises, these may be counted on the fingers. The firm of Steinway, of New York, U.S.A., boast of making every part of their pianos, having several factories and an iron foundry, but they are an exception. There are a variety of actions in the market, each having its particular claims to merit, but the maker exercises his discretion as to the one he adopts. It does not come within the scope of this paper to notice the merits or demerits of the various actions. As for the piano we are making, we only need one; it will be enough for the present to describe this one. The action I have selected for this piano is what is known as the tape action, from the fact of it having a tape or bridle attached to the hammer butt. This action was patented in England as far back as 1842 by Robert Wornum, who spent a large amount of time and money in perfecting the pianoforte, but it did not find the favour in this country that it deserved, illustrating the old proverb that no man is a prophet in his own country. But the French makers soon discovered the merits of this action, which was so much used in France that it acquired the name of the French action. Latterly, however, it



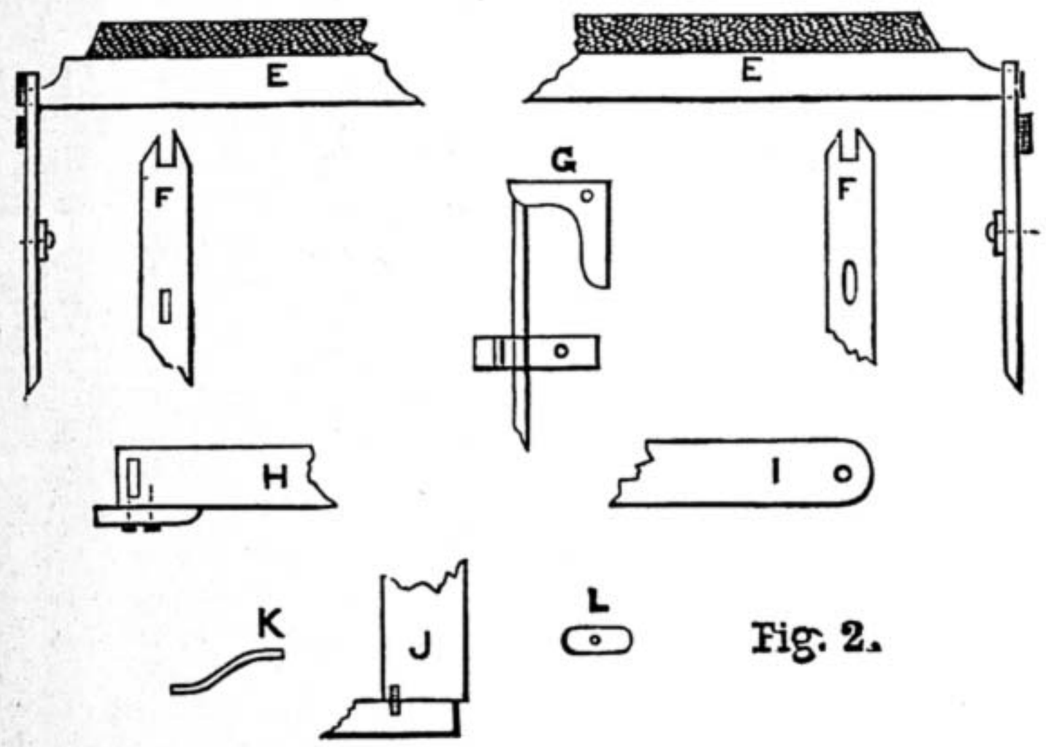


Fig. 2.

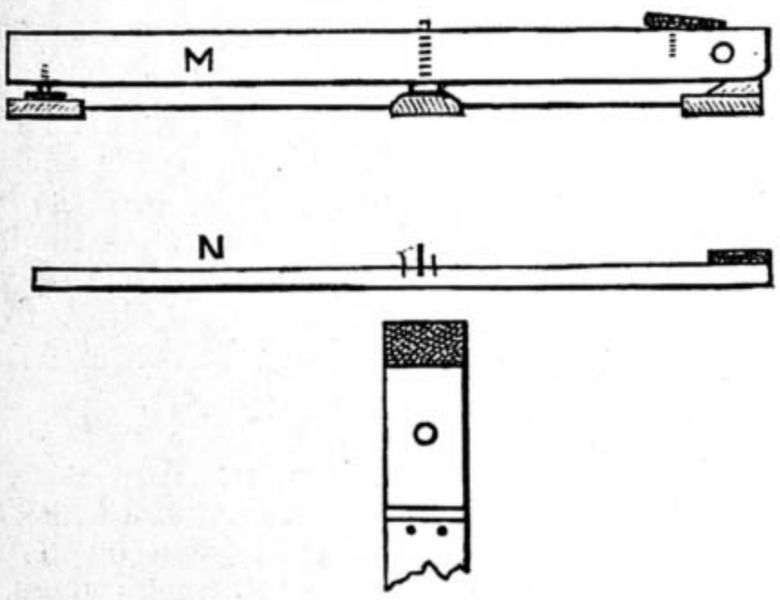


Fig. 2.—Diagram showing Arrangement of the Pedals and Rockers, and their various parts. (Scale, 1 inch to 1 foot.)

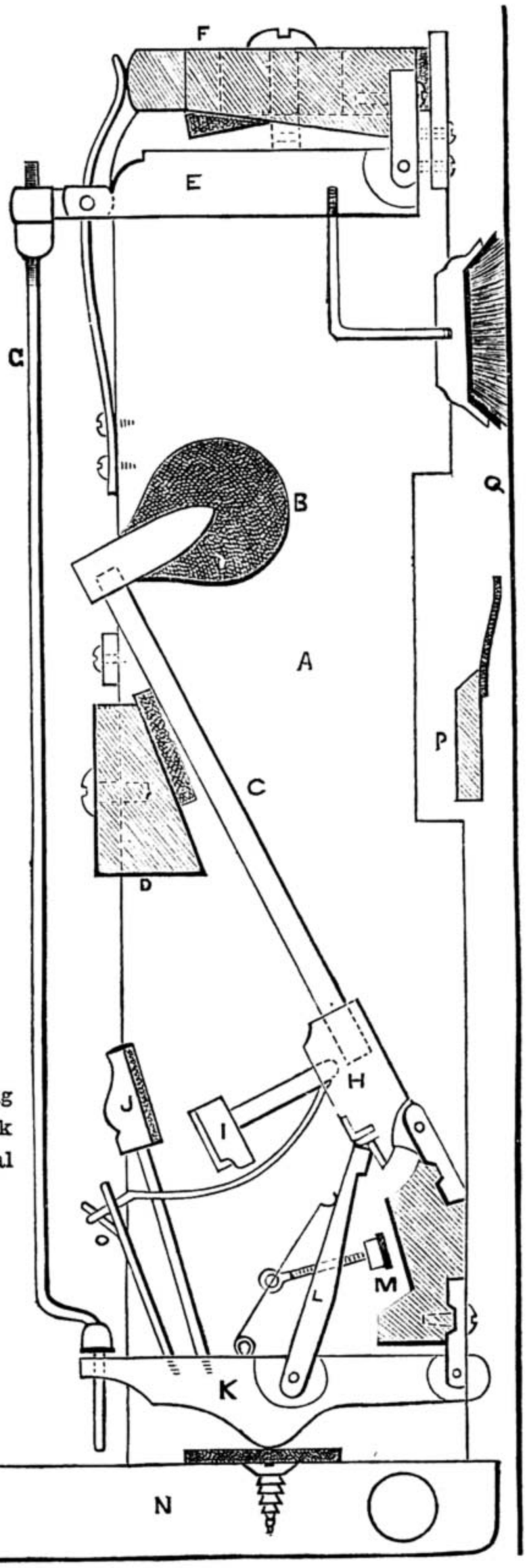


Fig. 1.—Diagram showing Section of Tape Check Action. (Half actual size.)

Fig. 1.

References to Letters in Fig. 1.—A, Standard; B, Hammer; C, Hammer Shank; D, Hammer Rest; E, Damper; F, Damper Rail; G, Damper Wire; H, Hammer Butt; I, Check Arm; J, Check; K, Lever or Crank; L, Hopper or Fly; M, Set-off on Side Rail; N, Portion of Key showing Pilot Screw; O, Bridle and Tape or Stay; P, Section of Celeste; Q, String. In Fig. 2.—A, Pedals in Position and Arrangement of Rockers; B, Plan of Rockers; C, Overlapping of Celeste Rockers; D, Plan of Pedals; E E, Plan of Celeste with Section of Sticks; F F, Plan of Pedal Sticks to support Celeste; G, Crank showing Method of Working. H, Bass End of Damper Rail; I, Treble End of Damper Rail; J, Method of fixing Standard and Standard Block; K, Spring for Front of Damper Rail; L, Wood Button to secure Action; M, Sketch of Key; N, Section of Balance Board; O, Plan of Balance Board.

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has found more favour in the land of its birth.

The action forms a very important part in the construction of the piano, as without it the piano would merely be a large dulcimer. The action and keyboard form the link between the performer's hands and the strings. There exists much difference of opinion as to the weight or balance of a key or note, as when the key is pressed down and the finger taken off, it is returned to its former position by a weight at the extreme end of the key, and also the weight of the action. Some prefer a light touch or fingering of the keys, while others are in favour of a heavy touch; I think, without offering a decided opinion, it would be as well to accept the happy medium. For if a touch is too heavy, it renders playing for an hour or two more the nature of work, as it makes the fingers and wrists ache; while, if too light, you cannot feel enough weight under the fingers. The reader will find in very old pianos the touch is very light, while in the modern pianos they have a decided tendency to be heavy. The action I have selected for this piano will require a weight of two-and-a-half ounces to press the key down of each note, so that the hammer strikes the string. A person playing, for instance, the popular piece of music, "The Maiden's Prayer," presses a key down 1,220 times, which is equal to raising a weight of about 82 lbs. So the reader will readily understand that if a touch is heavy, and a person plays for some hours, how tiring it must be.

I will now enumerate the different parts of the keys and action as they are known in the trades. Beginning with the keys, we have the key frame on which the keys work, comprising front rail, balance or middle rail, and back rail; in the front and balance rail are key pins, those in the balance rail penetrating the keys, while those in the front rail partly do so. On these pins cloth is placed to prevent noise, the back rail also having cloth to form a cushion for the back of the key to rest on. The keys in a seven-octave piano are eighty-five in number, being fifty white or natural keys, and thirty-five black or sharp keys. The parts of the tape action are named standards, damper rail, hammer rest, set off or slide rail, hammer, damper, lever or crank, hopper or fly, hammer butt, check arm, check, bridle or tape, escapement button, bridle stay, and damper wire. You will now require your keys and action to commence work as the finisher; the keys you may obtain from F. Edwards, 63, Southampton Street, Pentonville, N. In ordering, ask for one set of keys (ordinary scale), ivory or celluloid according to your means, as ivory would cost more, 14 in., 7½ in. balance. The action you can procure from V. A. Hallpike 213, Mare Street, Hackney, E.; order one tape check action (ordinary scale) 10 inch strike, with hammers complete.

Your first business will be to set up your action in the cases; take the two screws out of each end of your damper rail and put it aside for the present; now take the extreme bass and treble hammers out of the packet they are in, and file the ends of the shanks until they fit the holes in the hammer butts at each end of the action. In the bottom of each standard put a dowel, and make two blocks to fit them (see diagram); these are what the action rests on, and are glued on the key bottom when it is in position. Stand your action on the blocks, and put the hammers in the bass and treble holes of your action, and when the point of the hammer touches the string, see that the shank of the hammer is ¼ of an inch out of the upright or leaning back, both ends the same. Now keep the front edges of the standards upright or square, and mark the front of your standard blocks, and keep it in this position temporarily. You leave this for the present; put your keyboard on your bench; take the extreme treble and bass keys off the frame; take the treble one, and holding it $\frac{1}{16}$th of an inch from the front of the lock board, rub it under the treble note, and it having black lead on the bottom, makes a line on the top of your key; serve the bass end in the same way, and you have a line on each key. Put them in their places on the frame, and get a straight-edge and make a pencil line across the whole of the keys at the two marks, then take a centre-punch, and make a mark in the centre of each key on the line; in these punch marks holes are bored for ⅜-in. No. 10 screws, and countersunk so that the head is level with the key: these are called pilot screws; put these in. Now make a pencil line across the keys ¾ of an inch behind the screws; now take the keys off the frame, and the next operation will be to load them. There are two methods of loading them: you can either bore the holes in the keys, and melt the lead in a ladle and pour into the hole while holding the key on a flat-iron with the handle in your bench screw, or you can buy the leads moulded ready to put in the holes and make tight with a hammer; you will require them ½ an inch in diameter, one or two for each key, according to your balancing.

You now make a balance board: this is a piece of wood 3 in. wide, and the length of the key; mark one end for the back, then cut a kerf with your saw in the centre of the wood, and put a piece of thin brass or veneer in the kerf, allowing it to stand above a ¼ of an inch. Now bore two holes (for a wire nail with the head off, to fit in) ⅛ and ¼ inches in the front of the kerf; have one of your moulded leads ready; put your wire in the ⅛-in. hole, so that it stands above the level of the veneer an inch; put the centre hole of your key on, beginning at the bass end, then slide your lead towards the back of the key until it weighs it down. Now make a mark on your key at the place where the lead is, taking care that it does not come on the pilot screws: serve as many keys as there are dampers in this way; then you change your nail into the ¼-in. hole and weigh the remainder of the keys. In the treble the keys are a little heavier, to compensate for the weight of the dampers in the bass; you bore centre-bit holes in the keys right through the sides at the marks you made in balancing, and fill them up with lead; see that the lead does not move in the holes, to prevent rattling noises; as you hammer them in you can try if they are tight by pressing with the thumb.

You now want a strip of cloth 1¼ in. wide, and the length of the set of keys; let the cloth be of firm texture, such as box cloth or black cloth: this is glued on to the keys at the line behind the pilot screws, so that the cloth covers the screws; you only glue behind the screw, leaving the front of the cloth over the screws loose, as you may have to regulate these screws. After gluing, cut the keys apart with a knife; you will now require some baize or felt to put on your key frame—felt such as that used for putting under carpets will answer your purpose; put the two extreme end keys on the frame, and mark with a pencil the frame where it extends outside the keys; also see that the frame is level with the back of the keys: if it is not, plane it down, also cut the ends off the frame at the marks you made. You must now cut two strips of your baize or felt, one piece 1 in. wide, and the other 1½ in. wide, and the length of the key frame: these strips of baize are to form a cushion for the back of the key to rest on, and are placed on the back rail of the key frame, directly under the pilot screw; you gauge a line and make a groove with your rabbet plane about a ¼ of an inch wide, holding the rabbet plane at an angle so that it makes the groove deep enough for your 1½-in. piece of baize to lay in; the 1-in. piece is simply glued at its front edge and laid on the frame, and the 1½-in. is glued in the groove and lays over it. You will now want on the centre pins of your key frame small pieces of cloth the same kind that you used for the top of the keys. In the trade, it is usual to punch these out with punches for the purpose; as the reader will not be provided with these, he must cut a strip of cloth the width and length of the balance rail, and stretch it across the top of the pins, then rub a file along the top of the pins, and it will make a hole for each pin; then press the cloth down level on the rail. For the front rail you will require two strips of felt: cut these the width of your rail, and make holes in the same way; the keys are now ready to be eased on the frame. For this you will require two small files, one round and the other square; if you cannot get the size you require at the tool shop in your locality, you may obtain them from G. Buck, Tottenham Court Road, W.C.; by rubbing a piece of thin paper over the round and square hole, you would be able to send the size; you use the round file first, easing the round hole so that the key drops easy on the pins, but do not make it loose. Now use the square file for the top hole, and ease so that it fits; serve the front holes in the same way: of course you ease every key on the frame. Now put the set of keys as they are on the frame into the case; the extreme bass and treble hammers are put in the butt at each end of the action, and while the lever is resting on the key you plane down your blocks that are under the standards until the point of the hammer is 2 in. from the string at each end: this is technically termed the blow, as it is the distance the hammer has to strike or give the blow to the string. When you have got the blow the right distance, you move one of your hammers, placing it in several butts, to see that your hammers will strike each note squarely, and the shanks upright; you must move the action either to the right or left until you have got it right. Now mark the place where the blocks or standard feet are, and these must be glued down on the key bottom; put a screw through when the glue is dry, then take your keys out, and unhook the tapes or bridles off the stays: this you can easily do by using a pair of pliers; notice how they come off, as you will have to hook them on later. Now lay your hammers out on a clean board: you will find they are numbered on the side of each one; then take your extreme treble hammer and cut a piece off the end of the shank, until the point of the hammer strikes the string close under the bridge pin: this gives you the length to cut the hammer shanks. You will need a block to cut these, so that from the top of the wood of the hammer to the end of the shank they are all the same length; you can make this block by rabbeting the edge of a piece of wood 8 in. long, and making a saw kerf across at the

place you want to cut them. Having cut your hammers to the length required, you file the ends of the shanks so that they fit the butts; do not make them loose; begin at the treble, and take each one in rotation according to the numbers. While doing this you will have to lean the case back, as the hammers will have a tendency to fall forward.

After fitting them all in, take two small straight-edges about 8 in. long; begin at the treble, and place one on the top of the hammers and the other under the check arms, and see that the tops of the hammers and check arms are straight; if they are not so, file a little off the end of the shanks until they are. You now proceed to glue in the hammers: have your glue hot and of medium thickness, use a small stick to glue with, put a small portion on the shank, place in the first butt at the treble and turn the hammer round two or three times while it is in the butt: this forces the air out, and assists to set the glue. Now place the hammer up to the strings, and see that it strikes the note square; glue about a dozen in this way, then press one straight-edge under the check arms and the other on the top of the hammers, and see that they are straight; then draw the hammers back, and let them lean on your straight-edge about 2 in. from the strings: this is the distance of your blow. While they are in this position regulate the spaces so that they look even to the eye; serve the hammers right through the set in this way; now screw your hammer rest on with two screws. To find the place for this, lean the treble and bass hammer back, holding the hammer rest under them until the point of the hammer is 2 in. from the string: this will be the place for it to be fixed. When the hammers are all laying back on the rest, just look over them and see that they are to your satisfaction; when your hammers are dry, place all the tapes or bridles as before; now put your keys in the case, and take out the keys where the frame passes over the cross rails of the key bottom; then move your key frame to the right or left, until each key is under the lever of each note. Now mark the front, middle, and back rails of the frame for holes to be bored for screws to go into the rails of the key bottom. Having bored these holes, put your key frame in position, leaving a space of $\frac{1}{16}$th of an inch between the front of the keys and the lock front; screw down to your key bottom. At each side of the standards, blocks are fitted to fill up the space between them and the ends of the case: these are 1 in. in thickness, and are made of hard wood; the bass one has a piece cut out for a pedal stick to work through, the hole being lined with cloth; the pedal stick is tapered from an inch at the bottom to $\frac{1}{2}$ an inch square at the top. In a line with the front of the standard a $\frac{3}{16}$-in. slot is cut out of the blocks for a button to fit in which secures the action in its place; the position of these blocks on the ends of the case is 1 in. above the top of the hammer rest; put a screw through these into the ends, also glue them; now scratch a line under them on each standard and put a small dowel in, allowing it to stand out $\frac{1}{2}$ an inch: these press under the blocks and prevent the action from moving upwards; then screw one button on each standard to fit in the slots before mentioned: these you can make of beechwood $\frac{3}{16}$ths of an inch thick, 2 in. long, and $\frac{3}{4}$ in. wide round both ends and bore hole in centre for $\frac{1}{2}$-in. screw.

Having secured the action, you will probably find that your hammers do not lie evenly on the rest: some may be a shade high, while others may be low; by taking hold of the rest in the centre and pulling it forward, you will find some of the hammers follow the rest: these are low; take out the key and turn the pilot screw up a little until they remain stationary; if any stand a little above the rest, take the key out, put it on your bench, and give the cloth over the pilot screw a sharp blow with a hammer. The hammers being in line on the rest, the next operation will be to make the touch: that is, the depth the key presses down. Take two pieces of wood $\frac{5}{16}$ths of an inch thick, 2 in. long, and $\frac{7}{8}$ths of an inch wide; on the back of these is screwed a piece of lead sufficient to press the key down; these are named touch weights; one is placed on the front of a treble key, and the other is placed on a bass key, then a light straight-edge is placed from one touch weight to the other; if the keys are too high, and your straight-edge does not touch the weights, then your touch is too deep; you must alter this by placing a piece of cardboard under the front rail of your key frame; if your straight-edge rests on the touch weights and the keys do not touch it, then your touch is shallow: this can be altered by putting a piece of cardboard or thick paper under the middle rail of the key frame at the places where it is screwed; get it as nearly right as possible to the straight-edge in this manner, then you must take a shaving off the bottom of the high keys, while a piece of paper must be put on the centre pins to raise the low ones; those keys that are out of square may be made square by tapping the centre pin either right or left, as required; the spaces of fronts of the keys are now made equal by a key spacer: this is a forked piece of steel which moves the key pin to one side or the other; you can do it with pliers, but do not scratch the pins.

Having spaced the fronts, now space the sharps, and by tapping the centre pin of the sharp, space it between the two naturals on the balance rail; the backs of the keys are spaced by striking the key on the side with a hammer on a flat iron the way you wish it to move; strike on that side. Now you will have to fit the damper rail when the dampers are on the strings; the largest damper is for the extreme bass note. Let the rail hang over the standards $\frac{1}{2}$ an inch each end; at the treble end a hole is bored through for a screw to go in the top of the standard, while at the bass end a slot is bored out for a round-headed screw to go through freely so that it does not touch the sides; on the front of the damper rail at the bass end a piece of wood 4 in. long is screwed and glued on, and extends beyond the damper rail to within $\frac{1}{8}$th of an inch of the end of the case; behind this projection, a crank (which is screwed on the end of the case) works; it presses the damper rail forward, while a spring screwed on the front of the standard presses it back, the screw at the treble end acting as a centre, and the bass one keeping it in position; the bottoms of the dampers should be $\frac{1}{2}$ an inch above the hammers when they touch the string; if they are too high, you must cut a piece off the tops of the standards until they are right, then screw the damper rail on, and screw a stop on the back of the standard to prevent the damper rail going back too far, placing a piece of felt between to act as a buffer; there must be a space of $\frac{3}{8}$ths of an inch between the top of the damper and rail. You must now take a pair of long-nosed pliers, and put the damper heads on the string, bending the wire to right or left as needed, and keeping the tops of dampers and heads in a straight line; then put the damper wires in, screw the top button down until there is $\frac{1}{8}$th of an inch space or play between the damper and lever when the wire is in, put them in, and then cut off the tops level with the damper with a pair of pliers.

You now proceed to pedal the piano; to do this, you must put the piano on its back on two trestles, so that you can get at the bottom of it; make two pedals of beechwood 16 in. long, and the shape they are in the sketch, $\frac{3}{4}$ of an inch thick; mark 4 in. from the front, and put two pins in temporarily; this is the distance they stand out in front of the plinth; from these pins bore a hole in the right or loud pedal, $2\frac{1}{4}$ in., and bore a hole in the left or soft pedal, $3\frac{5}{8}$ in., for the pedal bolt to pass through: these are made of stout wire with a nut to screw on the top; also bore a hole in each $1\frac{1}{2}$ in. from the back for a stout screw to go through; glue a piece of felt on the bottom of each to prevent noise. You now mark the centre of the plinth, and $2\frac{1}{4}$ in. each side of this mark you place the pedals, that will leave a space of $4\frac{1}{2}$ in. between the pedals; cut pieces out of the plinth for the pedals to fit in, cut up to the bottom board of the case, leaving space for a piece of felt to go round the hole; this felt is glued in the holes and tacked under the plinth; now let the pedals rest on the pins, and put them in their respective holes, and mark through the holes you made for the bolts; at these marks bore two $\frac{3}{4}$-in. holes through the bottom board; now put your pedals in their place and put a stout screw in the bottom of each. Next get out the rockers: these you can make of deal $1\frac{1}{4}$ in. square, and one piece will be 2 ft. long, and two pieces 2 ft. 6 in. long; on the 2 ft. 6 in. rockers a small block is glued at the bottom 10 in. from the end, while the 2 ft. rocker has a block 8 in. from the end; take one of the 2 ft. 6 in. rockers, and put it on the bottom board, extending 1 in. over the hole of the right pedal, the block being 10 in. from the pedal, then mark through the hole, and bore a hole at this mark for the pedal bolt to go through, the other end of the rocker being cut so that it is a $\frac{1}{4}$ of an inch from the bass end of the case; the rocker is bored with an $\frac{1}{2}$-in. centre-bit half-way through over the block; then bore the remainder with a spoon bit for a 2-in. screw; from the hole at the bottom round the block over, and put a pedal spring on so that the point of it comes near the bolt hole; now clean this nicely with glass paper, rub some soap on the block and spring, put your bolt through the pedal from the bottom and through the rocker, put your screw in through the block, and then pull your pedal and see that it works free, without noise; you do the same with the back rockers, except that they overlap each other, and the pedal bolt penetrates both; the short rocker is at the bass end and the long rocker at the treble; rub plenty of soap where there is friction. By referring to diagrams you will see how these are arranged; the soft pedal in this piano is what is known as the celeste: this is a strip of felt or flannel on a slip of wood, so that when the pedal is depressed the two ends of the slip rise simultaneously, and interpose the flannel between the hammers and strings, and so softens the tone; the loud pedal moves the crank, which gives the damper rail a forward movement, taking

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the dampers away from strings, and allowing free vibration, and so making the tone louder. By referring to diagram, you will see that the two sticks which hold the celeste have slots in them; also a piece cut out of the top for the celeste slip to ride in; screws penetrate the slots into each end of the case to keep the celeste in position, so that it is near but does not jar on the strings; fit it so that the top edge of the flannel is ½ in. below the strike line when the pedal is at rest. You now make a crank as per sketch, of beech ½ in. thick: this is screwed on the end of the case above the damper rail at the bass end, the front of the crank being over the pedal stick, the back being behind projection of damper rail.

MEANS, MODES, AND METHODS.

Stone-cleaving Tool for Small Specimens.

To the lapidary, the geologist, and the amateur mineralogist, a handy tool to cleave with more exactness and less waste than by the hammer has been much wanted. Some specimens that have to be opened are so valuable extrinsically, from their rarity, that the small cost of this tool would repay the owner at once using. Its value may be judged when jade has to be cloven so as to produce two surfaces without fracturing any but the part to be divided; and such rare stones as chrysolite, aurite, pectolite, fluorite, coral, etc., to be opened in a direction for special results.

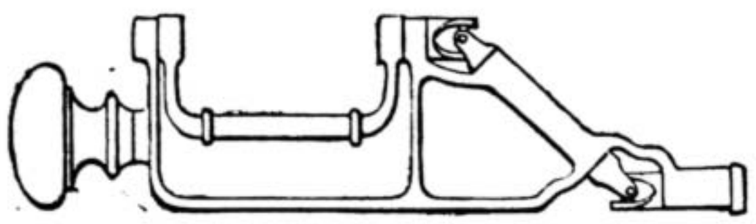
Such a tool was in use by one of the most scientific geologists in France, with the largest display of valuable minerals and fossils collected at the French Exposition—Mr. W. Foote, of Rue Desaix, Paris. It is an American invention of Mr. F. A. Clanfield, Dover, N.J., United States, for whom Mr. Foote is agent in France.

The illustration needs little description. It is nearly all cast steel, somewhat like the bed of a lathe, with two poppet-heads, each with a chisel in a socket-hole, with cross drift-holes, to enable the chisels to be driven out at any time. The head, A, is recessed into a slotted mortise in the bed-top, forming a movable joint, turning on the fulcrum-pin, B, by the purchase obtained by the screw, C. The shifting-head, E, has a tongue a third of the width of the bed-top, which is recessed into a long slot, F, shown by the dotted line. This is to take any side-rack. The movable "bridle," G, is the main stay to resist direct strain in cleaving stone. It consists of ½-inch square steel bond, fitting quite round outside of bed and poppet-head, secured only by the pressure in action, drawing it into angle-notches on the under-side of the bed. It requires no bench. A table serves to rest it on, as the resistance in cleaving is self-contained.

The force required for the hardest agates or gems is often less than for softer stones of the same bulk; but, so powerful is the leverage, that a lady can use it with ease. It is about 2 ft. long by 10 in. high.—J. C. K.

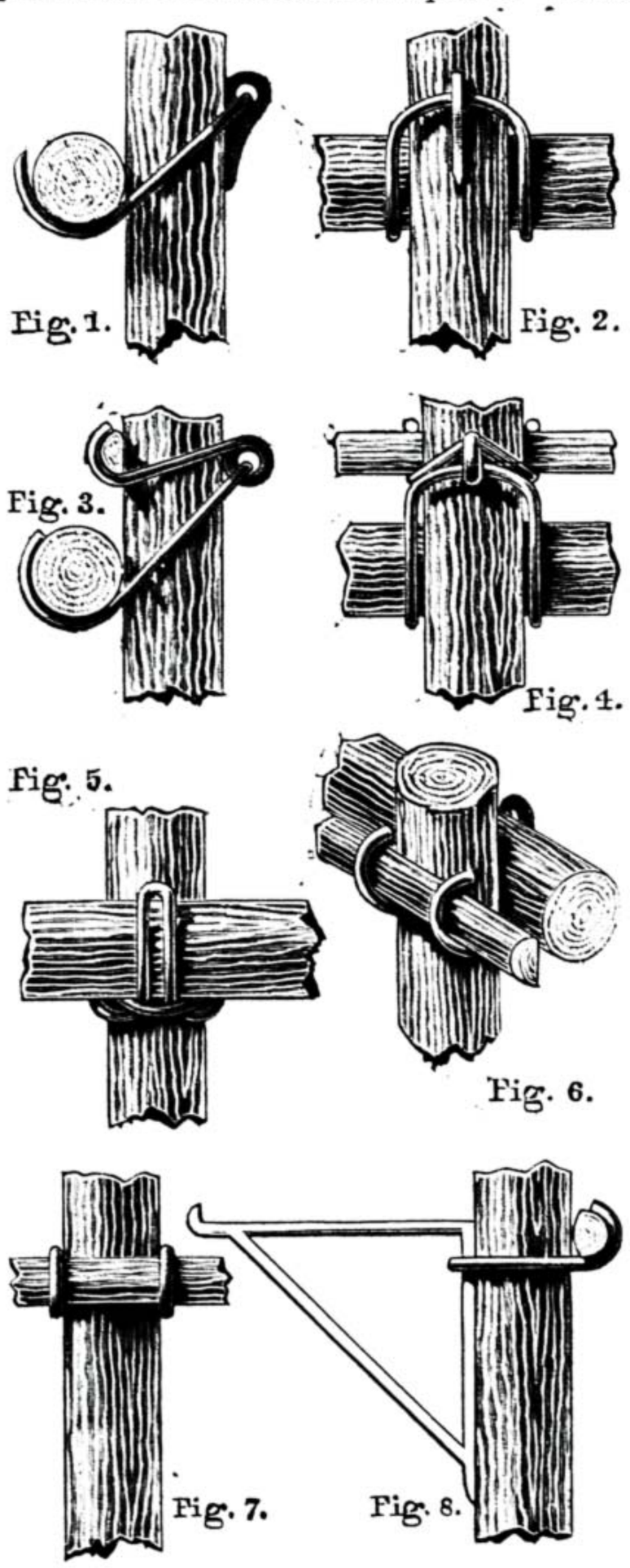
Science in Scaffolding.—Steel Ties.

To erect the scaffold from which a structure is reared is a skilful piece of handiwork. Recent improvements of elevated "stages," from which a building can be erected without the network of scaffolding, is a real scientific advance in building operations, but it is mostly restricted to very lofty buildings, so that scaffolding of the ordinary form will still be used for dwellings and factories of small altitude.



Brace for Boring in Angles.

Sometimes the new building falls to pieces "before there is time to get the paper on to hold it up," remarked a man on a jerry building that threatened to collapse when one of the doors slammed. The law is lenient to such malefactor builders, or it would not be attempted if the penalty was penal servitude for such delinquents. There seems a hiatus in building science existing between the architect and the builder. One often is biassed by rules, the other often ignorant of the simplest laws of mechanics, and helpless to fulfil the main practical purposes of his trade—make a sound building as a comfortable dwelling-house. Any one who has been "clerk of the works" on any large building must have observed this. A surveyor is often employed to fill in this hiatus, and often very efficiently links architectural and building sciences.



Scientific Scaffold Ties.

The scaffold has to be got together often by the humblest craftsmen in the building trades, often with the most inadequate materials, the pole-bearers and putlogs being old and decayed, especially the ropes. To aid the builders, any plan which combines safety and economy would be welcomed. A Swiss invention for that purpose is now shown by the accompanying illustrations. T. G. Grossman, of Seefeld, Zurich, is the patentee. He substitutes steel for cord in securing putlogs to poles. It was shown at the Paris Exposition, and every opportunity of examining the scaffolding was given to those interested in such matters. The structure shown had all the firmness of a permanent building when heavily loaded to test its strength.

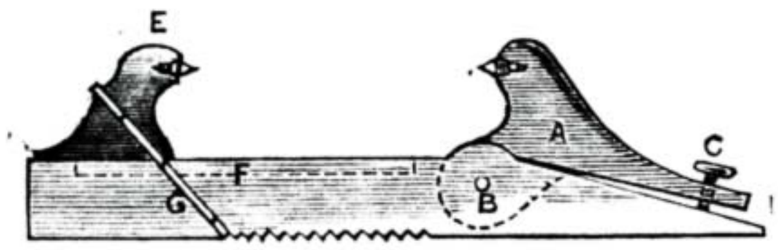
Fig. 1 shows the "dog-eye," with two "clutch-points" driven into the scaffold-pole, upholding a cross-pole. Fig. 2 is another view of the same. Fig. 3 is a scaffold iron with an extra double hook above the pole-hook for wedging the hook that holds the putlog tight. Fig. 4 is another view of the same. Figs. 5 and 6 show other forms. Figs. 7 and 8, the scaffold-iron used to hold an iron bracket wedged tight to the pole.

A practical builder would see at once the merits and disadvantages of the invention, and also see that the merits predominated for economy and security. He already practically employs a somewhat similar means in his "baulk-dogs," which require to stand exceptionally great strains. Such men are never slow to appreciate anything which is a practical and commercial economy in their trade. The way the scaffold was taken apart by two men was conclusive in the gain of time over using ropes to tie the poles together, and then wedging the tying tight, in scaffold-building.—J. C. K.

Brace for Boring in Angles.

All workmen, as well as amateurs, know how tedious it is drilling holes in the interior angles of furniture or buildings. The ordinary brace cannot be used for it. The geared brace, however small the mechanism, cannot drill one quite at the bottom of an angle and perfectly parallel to one of the sides.

A brace, similar to sketch, was shown at the Paris Exhibition, and seems to us to overcome this difficulty very well indeed. It is really a simple brace with the bit in a separate shaft, out of centre with the handle, but connected therewith by a double hook's joint.—H. B. P.



Stone-Cleaving Tool for Small Specimens.

SOME MORE PHOTOGRAPHIC APPLIANCES.

BY AN OLD HAND.

Draining Rack for Plates—Copying Easel—Instantaneous Shutters.

The Draining Rack for Plates is a very convenient, and almost, so to say, necessary adjunct to the photographer's material. It is made of two kinds, rigid and folding. Since the introduction of gelatine plates, development of negatives is usually carried on at home. The *raison d'être* for the folding form is gone; the only advantage of this kind was portability. To make a rigid one, cut out two pieces of ¾-in. pine or any other wood—it is immaterial—7 in. by 5 in. (Fig. 1). In each make two grooves, Y Y, 3 in. long and a ¼ in. deep, at right

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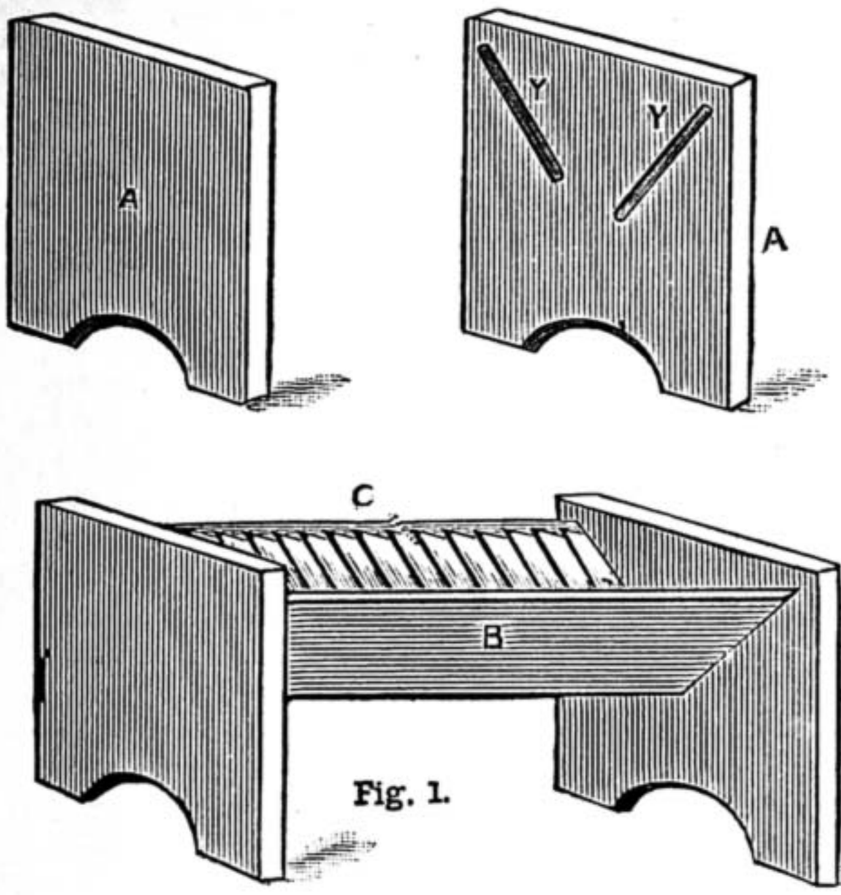
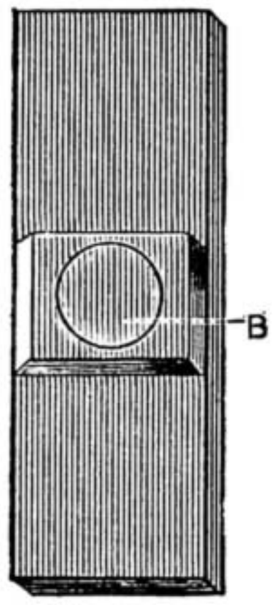


Fig. 1.



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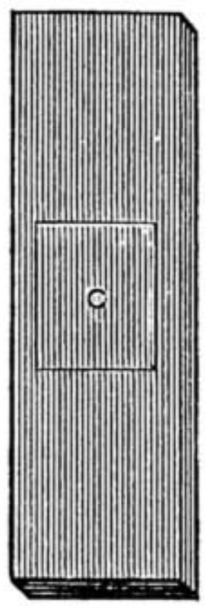

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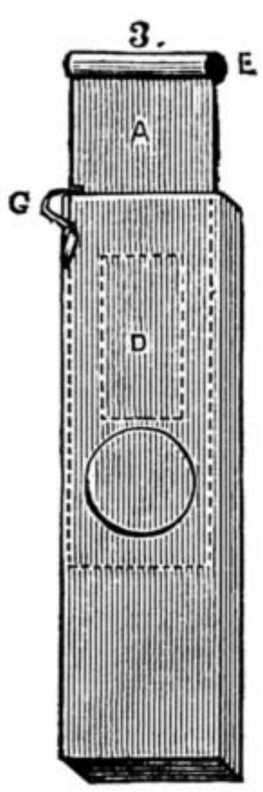

Fig. 4.

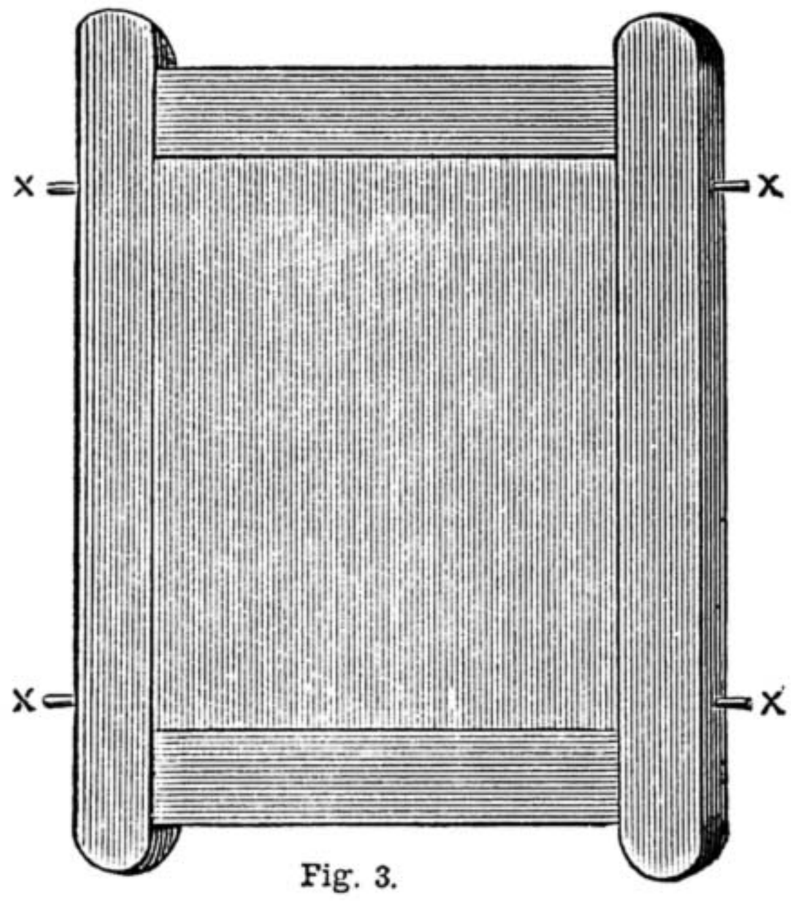

Fig. 3.

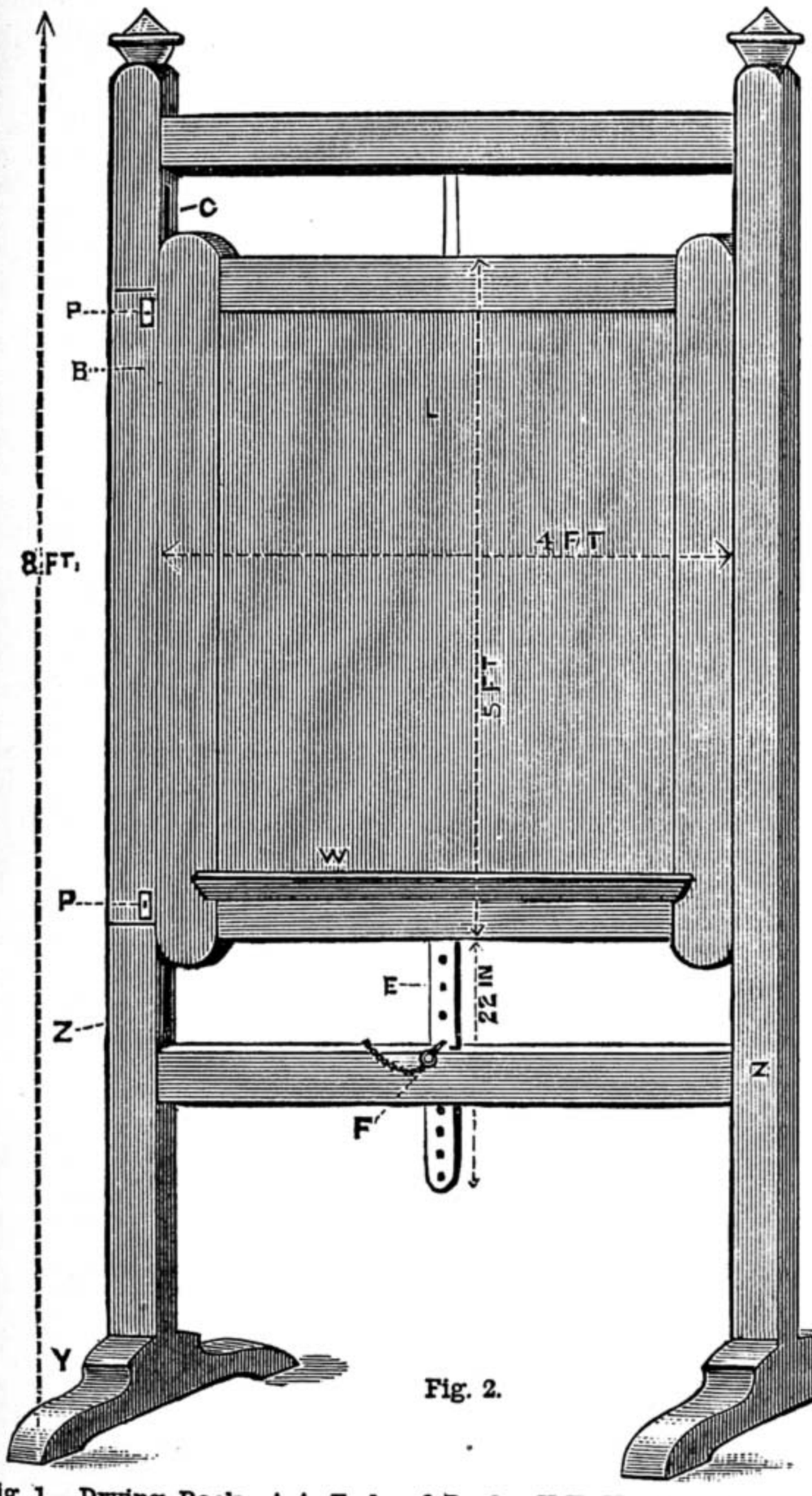

Fig. 2.

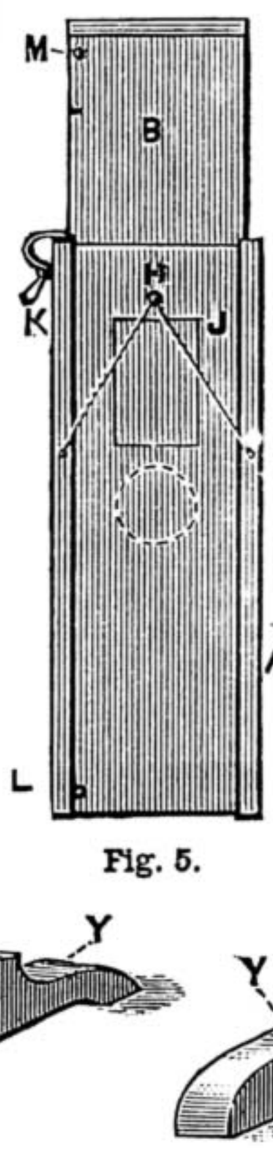

Fig. 5.

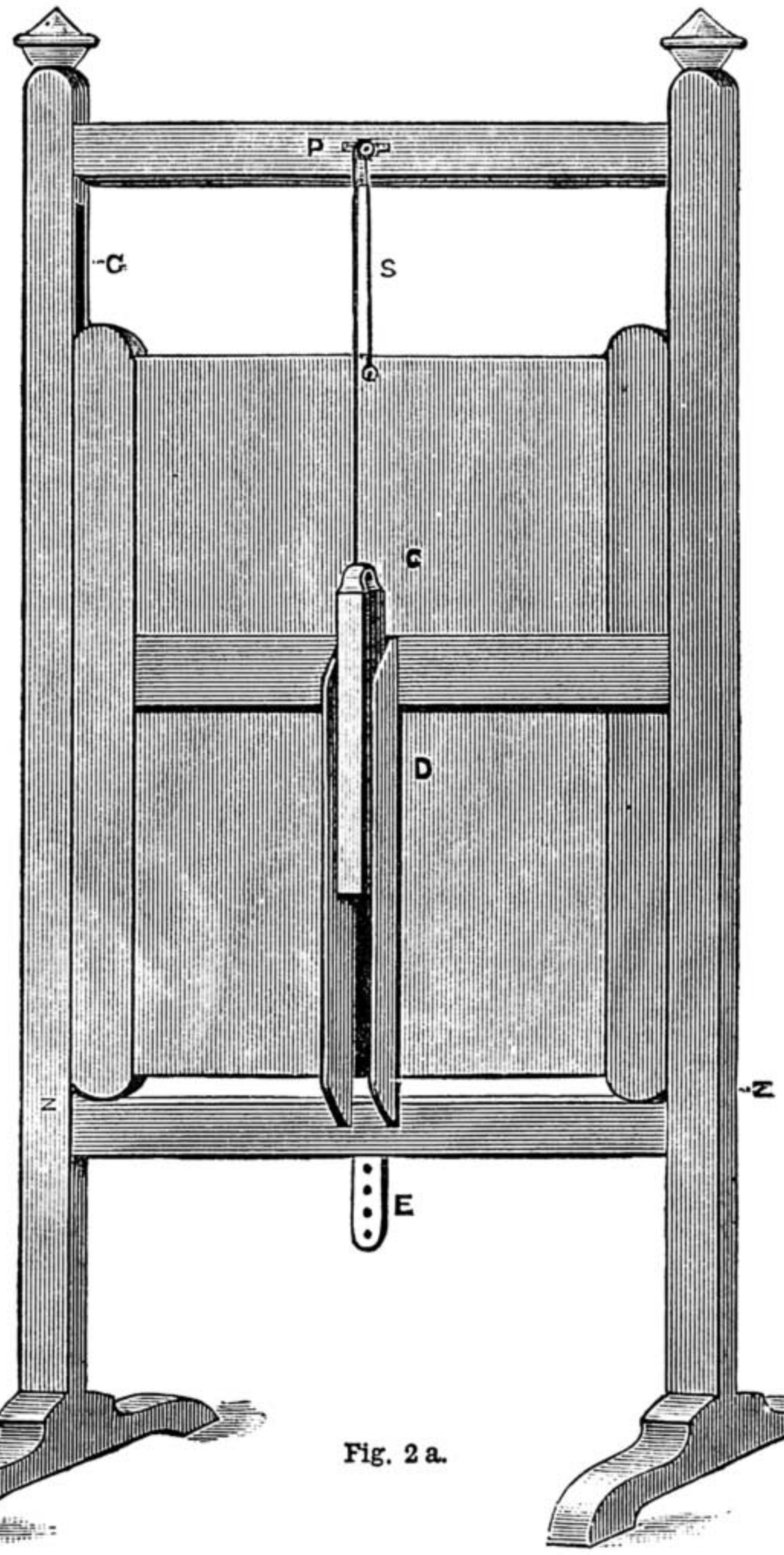

Fig. 2 a.

Fig. 1.—Drying Rack—A A, Ends of Rack; Y Y, Mortises for Supports for Grooving; B, Support for Grooving; C, Grooving. Fig. 2.—Front of Easel—Z Z, Pillars; L, Board; G, Groove; E, Iron Rack; F, Pin; Y Y, Solid Feet; B, Door; P P, Bolts. Fig. 2 A.—Back of Easel—G, Groove; Z Z, Uprights; Y Y, Feet; C, Weight; D, Case to guide Weight; E, Rack; P, Pulley; S, Cord. Fig. 3.—Board of Easel—X X X X, Pins. Fig. 4.—Drop Shutter—1, Back of Case; 2, Front of Case; 3, Shutter in Position; A, Ebonite Shutter; D, Opening in Shutter; E, Wedge Stop; F, Ditto; G, Catch. Fig. 5.—Modified Drop Shutter, working with Elastic Band—A, Case with Grooves; B, Ebonite Shutter; H, Pin; J, Elastic Band; K, Catch; L, Spring Catch; M, Aperture to remove Spring Catch.

angles to each other, as in diagram. Prepare two lengths of wood 3 in. wide and $\frac{3}{8}$ in. thick, as long as may be deemed convenient—12 in. is a good length. Nail and glue them firmly into the grooves to form a kind of bottomless triangle, and on the inside face of each attach some V grooving, made of either wood or zinc. The ordinary *straight* grooving of a plate box is sometimes used, but not to be recommended, as the edges of the grooves are likely to tear the film of negatives set in them to drain. The shape of the V avoids this fault. Care must be taken that the grooves are directly opposite each other. They are best fastened to their supporting sides by small screws, any projecting end carefully filed off. A coat of shellac varnish will complete it.

The Copying Easel.—In all studios where much copying is carried on some contrivance is requisite to support the picture, drawing,

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or whatever it may be, at a true right angle to the plate. The following easel (Fig. 2), although somewhat cumbersome, answers the purpose well. It will be seen to consist of two strong uprights on feet, framed together at the top and at a short distance from the floor, also centrally, a board working in grooves between them, kept in place by a rack and pin, and balanced by a heavy weight suspended in the rear. The difference in this from the ordinary artist's easel is that, instead of open framework, it consists practically of a large drawing board, on which can be pinned or fastened the drawings to be copied, an advantage that will be appreciated by those who have much of this class of work to do. To construct it, cut out two uprights, Z Z, 8 ft. long by $2\frac{1}{2}$ in. thick. The upper end of each may be somewhat ornamental, and the lower fixed into solid feet, Y Y. On the inside of one upright cut a groove 6 ft. long, G, and hollow the other out sufficiently deep to correspond with the opposite groove; and make up the outside with a hinged door, bolted top and bottom (Fig. 2 A), which, when closed, forms a groove for the projecting pins of the central board (Fig. 3, X X X X) to work in. To the centre of the bottom of the board fix an iron bar perforated with holes, half an inch apart, E, which passes through the lower connecting bar of the supporting frame, strengthened with an iron plate, and is retained at any height by the pin, F, being passed through and resting on the frame. On the lower face of the board is fixed a ledge, W, for the purpose of supporting framed pictures that would be too heavy to be supported by pins driven into the board, the usual way for light works. The diagrams will explain the construction in detail.

Instantaneous Shutters are, of all photographic appliances, perhaps, most varied in character, and may be numbered by the hundred, every maker having some pet design of his own that may embody some improvement on those that have been already constructed. The object in all cases is to give a brief exposure to the plate, always expressed in fractions of a second, in contradistinction to time exposures, which are generally understood to be from one second upwards. Some shutters claim to be under the control of the operator for any space of time, their speed being regulated by tension springs, and marked by a pointer on a scale. As to their accuracy for high speeds, it is somewhat doubtful. One of the first contrivances for instantaneous work, and which even now is not to be despised, is the drop shutter (Fig. 4), which we propose to describe. It essentially consists of a perforated screen, A, falling before the lens, the exposure taking place during the time the opening passes before the lens in the act of falling, the weight of the shutter being its only motive power. This speed may, however, be accelerated by the tension of an elastic band. This kind of shutter has several modifications, to work behind the lens, and through the lens mount itself in the position usually occupied by the diaphragms. The conditions essential for the satisfactory working of all shutters that are used in front of the lens, and attached to it, are, firstly, freedom from vibration during its action, and the absolute obscuration of light from the lens at other times. They should also be of as light weight as it is possible to make them, as they are generally used on small light cameras and lenses, that the additional weight of shutter on the lens hood tends to render less steady. Any shake produced at the *end* of the journey of the shutter is of no consequence, the exposure having been effected; but the *slightest* vibration during the time it is in transition is fatal to a sharp image. Such vibration is very difficult, if not impossible, to detect, except in the unsatisfactory result. A rough and ready method is by holding the lens in the hand whilst releasing the shutters, and noticing if there is any tremor during the movement. A very trifling jar may thus be detected. We will proceed to construct one. In the first place, the size of the lens for which it is to be made must be known, the diameter of the lens mount deciding the proportions of the shutter. A lens most frequently used for $8\frac{1}{2}$ by $6\frac{1}{2}$ pictures is the Rapid Rectilinear, the diameter of the lens hood being $2\frac{1}{4}$ in. We will take this as our guide. Plane and smooth some $\frac{1}{4}$-in. mahogany, or other light, close-grained wood, and make two pieces, $3\frac{1}{2}$ in. wide and 8 in. long. Glue a strip of wood $\frac{3}{8}$ in. thick and 3 in. wide across the centre of one of the pieces (Fig. 4 B), and when dry, cut an opening sufficiently large when lined round with a bit of cloth or velvet to fit the lens hood exactly and firmly; in the middle of the other, cut an opening $2\frac{3}{4}$ in. square, C. Blacken one side of each with black varnish or Stephens's ebony stain. The stain is, perhaps, the best. A strip of wood rather more than $\frac{1}{8}$ in. square is glued down each side to separate the pieces, and all glued and screwed together. We now have a shallow case, open at both ends (Fig. 4), with apertures in the centre of each, and facing each other. In a piece of ebonite preferably, although wood will do, $\frac{1}{8}$ in. thick and 14 in. long, the width of the inside of the case, make an oblong opening, D, 4 in. long and $2\frac{1}{4}$ in. wide, so that it will pass through the case with little or no friction. A strip of wood, E, is attached to the upper end to act as a stop, preventing the slide from passing through the case after the exposure has been made. In order to prevent any rebound, the strip at the top is made wedge-shaped, as Fig. 4, F. This completes the wooden portion of the shutter, and it may be actuated by hand, but it is better to fix a catch, G, on the side engaging with small saw-cuts in the edge of the shutter. In order to ascertain the proper position for these cuts, pull out the shutter until the lower part entirely covers the opening of the lens, holding it up to the light to make certain that none can pass; then make a saw-cut in it just above the top of the casing. Push down the shutter until the opening is fully disclosed, and make another cut. A simple pivoted catch (Fig. 4 G) is now fixed to the side of the case, the end of which will just engage the saw-cuts, and retain the shutter in either position with the lens disclosed for focussing or obscured ready for exposure. A slight pressure with the finger now on the catch will liberate it and the shutter will fall, the wedge-shaped stop, F, preventing any rebound. The favourite method of working all instantaneous shutters is by the pneumatic release, which is simply an indiarubber tube with an air-tight hollow ball at one end and an expanding tube at the other. Pressure applied to the ball expands the tube at the other end pressing against the catch, and so setting it in motion. The time of exposure of course depends on the rapidity of the fall and the length of the opening. With a shutter as described, about the twentieth part of a second is occupied; this may be decreased by slightly sloping the shutter, so that more friction is caused, or the speed increased by attaching an indiarubber band whose elasticity will give impetus to the fall. This is a very useful shutter, and free from vibration, and much good work has been done by it. Instantaneous shutters for very high speeds are altogether more elaborate affairs, and are made by the judicious combination of wheels, levers, and powerful springs. A modification of the drop shutter is constructed by substituting a groove, as in Fig 5, for one side of the casing. A small knob, H, is screwed into the shutter; an indiarubber band, J, passes over it, being fastened at each end to the sides of the case; the shutters being drawn out, the band is stretched, and, on being liberated, drives the shutter along the groove. A small spring catch is fixed to the lower edge of the slide that falls into a slot at the end of the journey, thus preventing any rebound. This shutter is used horizontally, and the speed entirely regulated by the strength of the elastic band.

The roller blind shutter is, as its name indicates, made on the principle of ordinary spring roller blinds, and may either be used behind the lens or before the plate, working either from right to left or from top to bottom. The blind itself is made of opaque material, with an opening cut across the centre of about half an inch in width and of the length of the plate, or diameter of the lens, according to the position it is intended to occupy in the camera.

Another very good form is the double drop shutter, designed by Mr. A. Cowan, and intended to work behind the lens, and is practically part of the camera front, working quite independently of the lens. This is constructed of two separate sliding pieces, one above the other. On applying the release, the lower part falls, disclosing the lens; and, on removing the pressure on the indiarubber ball, is rapidly followed by the other, which covers it again. It is not a very rapid working shutter, but sufficiently so for most purposes. Very free from vibration, the fact of its being attached to the camera instead of the lens is greatly in its favour, as any lens can be used, irrespective of size. The convenience of this form has made it a favourite with many leading photographers. Time exposures can be readily given with it, the exposure continuing so long as pressure is applied to the ball; remove the pressure, and the lens is at once closed.

OUR GUIDE TO GOOD THINGS.

*** *Patentees, manufacturers, and dealers generally are requested to send prospectuses, bills, etc., of their specialities in tools, machinery, and workshop appliances to the Editor of* WORK *for notice in "Our Guide to Good Things." It is desirable that specimens should be sent for examination and testing in all cases when this can be done without inconvenience. Specimens thus received will be returned at the earliest opportunity. It must be understood that everything which is noticed, is noticed on its merits only, and that, as it is in the power of any one who has a useful article for sale to obtain mention of it in this department of* WORK *without charge, the notices given partake in no way of the nature of advertisements.*

120.—PATENT WIRE THREAD FRET SAW.

I HAVE replied more than once to correspondents in "Shop" that when I was in a position to state positively that the Patent Wire Thread Fret Saw was fairly on the market I would give the sizes in which it is made, and the prices current. I am now well able to do this, for I have received specimens from different quarters. A correspondent who gives no name sends two saws, and says, "The two saws enclosed are the finest, 00, and a thicker one, No. 5; they are made in sizes between. My correspondent signs

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himself "Bradley." Mr. Herbert Bolton, dealer in Fretwork Materials and Designs, 59, Burmantofts Street, Leeds, writes: "Herewith I beg to submit to your notice sample of the Patent Wire Thread Fret Saw that has been so much inquired for in 'Shop' for some time past. Will you mention in 'Our Guide to Good Things' that these are 7d. per dozen post free, or 6s. per gross? The sizes are from 0 to 5 inclusive." They are also kept on sale by the old-established firm of Messrs. Moseley & Son, 323, High Holborn, London, W.C., who wrote to me a short time since to say that they are now prepared to supply them. These saws are so constructed that the teeth project on all sides, and as the teeth run in a spiral from end to end it appears that the saw teeth are first cut in the ordinary way, and the blade is then twisted in order to give it its new form. The advantages claimed are: (1) That it will cut in any direction, so that it is unnecessary to turn the work; (2) that it never sticks fast but constantly frees itself; (3) that it is stronger than any other saw; (4) that it retains its cutting powers longer; and (5) that it cuts more rapidly than any other saw. Further it is said that the performance of this ingenious invention is most surprising in the way of cutting, and that the peculiar make renders it entirely free from all the faults peculiar to the ordinary fret saw, and capable of doing work that cannot be accomplished by the latter. A considerable saving of time is said to be effected by its use and its practice. Although its cost is somewhat higher it is found to be more economical than the straight fret saw, because a greater amount of work, on the average, can be done with each individual blade. Readers will find from their own experience, on making trial of them, whether this be so or not. For myself, I regret to say that I have not yet been able to find time or opportunity for testing them.

121.—"The Amateur."

I trust that amateurs who stand in need of more patterns for fret-cutting, wood-carving, and ornamental woodworking generally than can be given in Work will not forget the monthly magazine entitled "The Amateur," a serial publication of continental origin and production, published in this country by Mr. Henry Zilles, 24 and 26, Wilson Street, Finsbury, London, E.C. The third volume is commenced with the January part, and as the year is yet young a favourable opportunity for beginning presents itself to intending subscribers. In the December part, completing Vol. II., some excellent patterns were given for chip carving, or "notch cut work," as the Germans call it, a kind of surface ornamentation, with small carving tools, which is easily done, and is beginning to find much favour among ladies.

122.—Walker's Turning Patterns.

Mr. F. J. Walker, 41, St. Helen's Street, Ipswich, sends me a sheet of patterns for turning, comprising knobs, finials, spindles, pillars, etc., well proportioned and excellently drawn, and writes: — "Herewith I beg to hand you advance sheet of a set of turning patterns which I am preparing for publication. The set will consist of 50 distinct patterns in 5 sheets of 10 each. They will all be the same size, and equally well drawn as the enclosed, the only difference being that those for sale will be printed by the ferro-prussiate process direct from the tracings. I would beg to call your attention to the fact that these patterns are not stencilled copies of common mouldings, but originally and accurately drawn. I shall issue the first 100 sets to the readers of Work at 1s. per set, after which the price will be 2s." Let me warn my readers that there are only 99 sets to be had at the low figure named, as I have taken advantage of priority of knowledge, and secured set No. 1 by lodging the required coin of the realm with Mr. Walker. It is the best testimony I can give with regard to the excellence of his patterns from my point of view, judging from tracing of Sheet 1.

The Editor.

SHOP:

A Corner for Those who Want to Talk It.

NOTICE TO CORRESPONDENTS.

*** *In consequence of the great pressure upon the "Shop" columns of* Work, *contributors are requested to be brief and concise in all future questions and replies.*

In answering any of the "Questions submitted to Correspondents," or in referring to anything that has appeared in "Shop," writers are requested to refer to the number and page of number of Work *in which the subject under consideration appeared, and to give the heading of the paragraph to which reference is made, and the initials and place of residence, or the nom-de-plume, of the writer by whom the question has been asked or to whom a reply has been already given. Answers cannot be given to questions which do not bear on subjects that fairly come within the scope of the Magazine.*

I.—Letters from Correspondents.

Angles for Hoppers.—J. G. W. (*Glasgow*) writes:—"On page 414, No. 26, B. A. B. gives a sketch of how to get the angle of boards for hopper, which is quite clear. Instructions are still wanting how to find the angle for butt joints when the top and bottom edges of the hopper are square to the faces

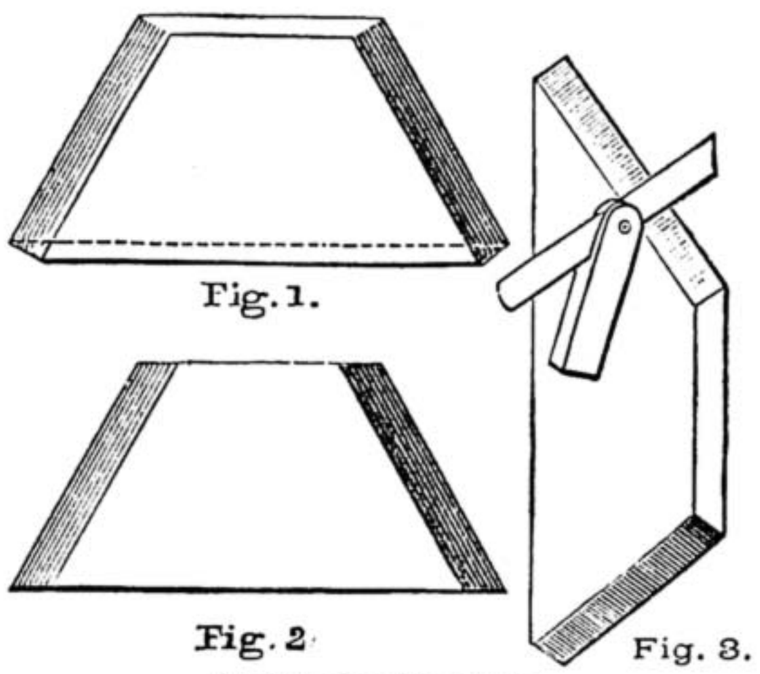


Fig. 1.

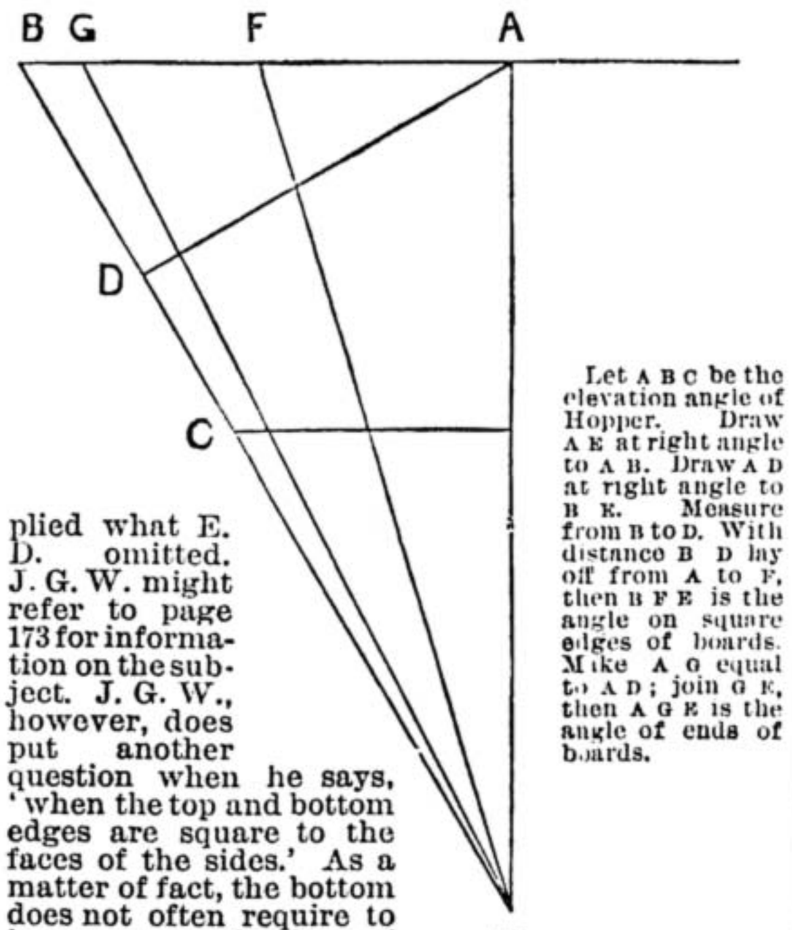
Fig. 2

Fig. 3.

Angles for Hoppers.

of the sides, as in Fig. 1, not as in Fig. 2—that is to draw down the angle for the butt joints, and set a bevel to it, and apply to the butt edge, as in Fig. 3. I think this is the point which most of us can't get over. If you possibly can make this clear, I think the mystery will be solved."

"In answer to J. G. W. (*Glasgow*), may I be permitted to say that my reply, which he understands, was only supplementary to that written by E. D., and printed on page 173, June 1. I therefore only supplied what E. D. omitted. J. G. W. might refer to page 173 for information on the subject. J. G. W., however, does put another question when he says, 'when the top and bottom edges are square to the faces of the sides.' As a matter of fact, the bottom does not often require to be square to the face of sides. I will try to make it plain. He (J. G. W.) will also notice I give another but equally correct plan for getting angle of ends of boards. Scarcely any books give any help on this subject.—B. A. B."



Let A B C be the elevation angle of Hopper. Draw A E at right angle to A B. Draw A D at right angle to B E. Measure from B to D. With distance B D lay off from A to F, then B F E is the angle on square edges of boards. Make A G equal to A D; join G E, then A G E is the angle of ends of boards.

Angles for Hoppers.

Registration of Printers.—W. I. W. (*Banchory, N.B.*) writes:—"H. E. C. (*Wednesbury*) writes in 'Shop' (see page 509) about registration of printers. Being a printer in a small way I intended to follow his advice, and have myself registered with the Clerk of the Peace as stated. I applied to the Clerk for County of Kincardine, but he is not aware of on what conditions a printer may carry on his business, and if they have to be registered, he says, it is not with him. How does H. E. C. account for this?"

Taking out a Patent.—Loco (*Finsbury Park*) writes:—"As one greatly interested in Work from its commencement, I was glad to see an article on the above subject (see page 515), as I believe many would-be inventors are kept from availing themselves of the protection afforded by law, through their ignorance of the mode of obtaining a patent. To such as these your correspondent C. C. C. has afforded some valuable hints, while at the same time he seems to have fallen into the same error as, I might say, the majority of those for whom his article is intended—that is, that as soon as provisional protection is obtained the inventor is safe, or, to quote his own words, 'is safe (meanwhile) as if the patent had actually been granted.' Now, although provisional protection secures us against subsequent applicants, and also secures to us the right to publish and use the invention without prejudice to the patent to be obtained, it does not secure to us the full rights of a patentee—that is to say, the right to prevent others from making and using the invention to their own profit. For instance, suppose our imaginary friend, the inventor of the wheelbarrow, after getting provisional protection for his invention, forthwith starts to make and sell the same. A second individual or imitator (of which there are many), seeing that the invention is only provisionally protected, also starts to make and sell similar wheelbarrows. Then the original inventor has no remedy whatever, as he cannot sue the imitator for any act of infringement committed before the patent is actually granted. Any profits that the imitator may have gained are therefore legally his own. I do not see exactly why your correspondent should prefer to describe everything so fully by the aid of drawings, as when the complete specification comes to be filed he will then have to adhere pretty much to the description given in the provisional specification, as the examiners are sure to object to anything being inserted in the complete specification which was not indicated in the provisional specification. Your correspondent C. C. C. would have done better to have left out the claim which he makes at the end of his specification, as no such claim is necessary in a provisional specification. Where a complete patent is taken out in the first instance in addition to the two forms marked C, a form marked A or A¹, bearing a £1 stamp, as in the case of provisional protection, is also required. It will thus be seen that the forms for the complete patent will cost £4, the same as when a complete is filed after a provisional."—[With regard to Loco's comments on what has been said *à propos* of provisional protection, I must still be allowed to retain my former opinion. I know that the words of the official circular are that "Provisional protection entitles an applicant to use and publish his invention without prejudice to his patent rights, but does not protect him from the consequences of infringement," and that this would seem to credit it with a very limited value only. But it appears to me that the common opinion drawn from experience may give a more true appreciation of it. A rival maker may, as Loco suggests, make and sell a similar article. But he cannot well do so without its coming to the ears of the inventor, who thereupon completes his patent, and stops the sale, with probably a result of loss rather than gain to the pirate. Or, a second inventor may, in the interim, obtain protection for a similar invention. Such a case has occurred within my own knowledge; but the first applicant having the right to complete first, did so, and the second inventor had simply to withdraw. Only a negligent inventor will, as it appears to me, be otherwise than virtually safe. As regards a claim in the provisional specification, it is immaterial; additional claims can be added in the complete specification. It is rather a matter for individual judgment. As to Loco's objections to the free use of drawings, let me say that an inventor ought to be able to adhere pretty much to his drawings; but he can, if he pleases, add others in his complete specification. I have added a converse method in one case, and no objection was made to it by the examiner. Loco will, I think, see therefore that his objection is of no great moment, whilst the following special advantage may be instanced. If he bears in mind that "pictures are the books of the illiterate," he will see how much better the working man understands the specification when it is read over to him, if it is freely explained by drawings. In most cases where a working man has come to me, he has first made a model, and the parts of this he recognises in the drawings at a glance, and is able to detect any little omission should there be any. I imagine also that explanation by drawings must save thought and time to the officials at the Patent Office.—C. C. C.]

Simple Incubator.—J. E. L. (*South Lambeth*) writes:—"In reference to B. F. (*Liverpool*) (see page 557), I beg to ask if he will kindly give us more explanation respecting the simple incubator, with garden pots, which he shows in his diagram, marked D, D. Do they both join together, or is there a passage through, and what is the supposed amount of heat from the lamp to produce satisfactory results? Has the box a door to it or is it left open?"

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II.—Questions Answered by Editor and Staff.

A Baby's Crib.—Clydeside.—I do not think the construction of a baby's crib should be beyond your power. Of course, knowing nothing of your skill in joinery, or the size of the baby, which is a variable term—one has known babies of seventy-five—it is hard to give exact details or measurements. Speaking roughly, I should think a plan about 4 ft. by 2 ft. 6 in. would allow room for growth. I should take four upright posts, at the usual height from the floor, and mortise in cross pieces; or, if this be too technical, use thicker wood and simply screw each piece. A top rail at the usual height might be added, with a railing of either straight or turned wood to keep the precious contents from early nocturnal expeditions. The floor, so to speak, of the bed could be made of sacking nailed to the four pieces of the frame. If space permits, it may be possible to give a working drawing of such a thing, which would no doubt meet the wants of many. But for the sake of household peace, remember the old rhyme, and see that whatever may be made is strong, else down may come baby, crib, and all, and this member of the staff of Work become accessory, however innocently, to baby slaughter. Knowing the peculiarly destructive power of the young Briton, I should suggest cast iron or wrought steel as the best material, did not I fear the flippancy of the advice, no less than its impracticability, would be condemned. Seriously, no work could be more deserving of honest praise than such as you purpose, for the love of a strong man for his child is perhaps the most sacred thing of this life, and if the above remarks seem too jocular, I pray you pardon them, for I know no nobler instinct than this fatherly care for childhood.—J. G.-W.

Organ Engine.—A Well-wisher (*Chichester*).—The Otto Silent Gas Engines are made from half horse-power upwards, and are adapted for organ blowing. If your single manual organ is not a large one, I should think the half horse-power engine would be sufficient for your purpose. I am unable to give you any information as to the price of the engine, but if you communicate with the vendors, they will no doubt be pleased to furnish you with full particulars. I believe the engines consume about 23 feet of gas per hour per indicated horse-power.—M. W.

Binding Single Plates.—Clydeside.—That "Bookbinding Made Easy" proved intelligible to you is somewhat of a relief to its author, for a dear friend who told him the sort of truth dear friends are apt to indulge me with, said he tried in vain to understand it. The great obstacle to binding single pages is that, try how you will, the book will not open flat, unless you paste each couple together with a strip of paper folded at the back, and thus make them, to all intents and purposes, ordinary folio sheets. If this course is not adopted, and it is a tedious and delicate task, the only other way I know is to lay all the pages in a pile with their edges exactly true, then taking a finely pointed bodkin or bradawl, bore a series of holes some quarter inch from the left-hand margin, and stitch them firmly with coarse thread or fine twine. So far it is plain sailing, but immediately the difficulty arises how best to fix them in a cover, and although I have tried a dozen makeshifts, I must own I never succeeded in doing so with a stiff cover, and now always fold a piece of limp cardboard, scored to fold with a sharp clean angle, just over the whole lot of prints, and bore the holes through it, stitching it with the pages themselves. If a piece of linen or buckram is pasted over the back to keep the stitching firm and safe, the book is well preserved, but it does not lie open as a book should. On the whole I should recommend, if the book is one likely to be used for reference, or still more if wanted for purposes of copying the plates—supposing them to be designs of some sort—that Clydeside should boldly face the trouble of affixing strips of paper to the backs and treat them as if they were ordinary pages.—J. G.-W.

The Mail Cart.—G. F. (*Nottingham*).—An article has been written on the mail cart with drawings of same, and appeared in Work, No. 30. There are three different designs, each possessing a novelty in the make. Since the article was written I have thought over a plan whereby a lifting hood might be made to fit the cart to protect the children from sun or rain.—W. P.

Ladies' Work Box, etc.—S. H. D. (*Newtown, Mont.*).—Every endeavour will be made as successive numbers appear to meet the desire of subscribers for small things, as well as large. In due time the wishes of yourself and your six friends shall be fully met, but it is not possible, as you must know from everyday experience, to do everything at once. Something, and indeed many things, must be kept waiting.

Combined Bed Suite.—J. H. H. (*Oldham*).—I venture to submit rough sketch of combined bed suite with less work in it than that published. I do not think it advisable to take away any more wood, if it is intended to make it a large job as per sketches. If a smaller article is required the bottom part might be taken away bodily, and the top part rest on four stout legs, the whole panel of the door falling down as flap, and being hinged to the bottom door stile. Concerning the thickness of wood I had more than one reason for giving it as ½ in. Firstly, it will be apparent that if it is made as in No. 26 of Work, and the wood is even ⅛ in. thicker throughout, it will increase the weight of job to nearly a quarter as much again. Secondly, this extra wood means extra expense. Thirdly, if made in comparatively thin wood, as there are so many boards connecting with each other, it will have a sufficiently firm and solid appearance. In the sketch, however, ½-in. wood would scarcely be the thing, as there is so much space to counteract the effect of the wood. I should say have the sides and the long door ⅞ in. thick, and the centre upright board and the horizontal ones ¾ in. thick. The glass door might be ⅝ in., and the drawer fronts ½ in. You will see that I show two knobs on the

Combined Bed Suite.

long door stile. One is to fasten the flap, the other the whole door. So far as I can recollect, I believe I showed this in my original drawing. Whether or no I cannot positively say, but if I did the engraver must have left it out, probably considering it was a mistake, or else concluding that one knob would fasten the flap to the stiles, and the door to the job. This latter could be done, but then the flap would always be loose, unless the door were shut. In the present sketch I have shown the glass door rests at the top, to come within the thicknesses of the two sideboards, and not on them as in Work No. 26. If the centre shelf is placed at the proper distance it will form a support for these rests, to keep the glass at the angle.—J. S.

Punching Dies.—R. G. (*Denham*).—Punches and dies are hardened by heating to a low red, and plunging in water. You ask for a few hints on hardening and tempering in general. This is almost entirely a matter of practice, but the following are of the nature of fundamental principles:—(1) Hardening almost invariably precedes tempering; the reason being that it is easier to lower a body to a definite grade of temperature than to raise it to that grade. (2) Since all articles are liable to warp in hardening, various practices are necessary to lessen this tendency, as heating articles in boxes to render the temperature equable, plunging vertically into the hardening mixture, cooling between plates when the articles are thin, and using lukewarm and oily or medicated mixtures. (3) The less often steel is passed through the fire the better, and overheating should be scrupulously avoided. A clear fire should be used, and charcoal is better than coal. (4) The scale should be ground off before heating, and the oxide produced by the fire rubbed off with a stone, and then with waste to render the changing colours visible. (5) Small objects are better heated on a hot bar of iron than in the fire, as the colours are then more readily observed, and the temperature under better regulation. The shank of the tool is often used as a reservoir of heat for the cutting point, communicating its heat thereto until the right colour is obtained for quenching.—J.

Siemens' Drum Armature.—Puzzled (*Burnley*).—The machine you saw was probably one of Siemens and Halske's continuous current dynamos. In these machines the ends of the armature coils do not each terminate in two segments of the commutator as in the form known as the Siemens H armature. In the machine you describe there are 12 coils on the armature, and 48 bars on the commutator. The ends of each coil, therefore, branch out to four different bars arranged on opposite sides of the commutator. Each coil of this armature is made to cut the lines of magnetic force four times during one revolution of the armature, and this gives a certain continuity and regularity to the current. If you care to go into the subject further, you will find a full description of these machines, illustrated by diagrams, on pages 299 to 302, part 5, of "Electricity in the Service of Man," now being published by Messrs. Cassell & Co., Limited, at 6d. each part. I can highly recommend this book to all students of electricity.—G. E. B.

Violin Bow-hairing.—Jeune Écolier.—I am preparing a paper, with illustrations, on the above subject, which will appear as soon as space permits. Organ and harmonium building will be thoroughly treated in Work.—B.

Violin Strings.—Sheffield Blade.—I cannot obtain the information you desire, but surely if you pay the price you will have no difficulty in getting the strings you require. Try Tarr, of Orchard Street, in your own town.—B.

Flux for Solder.—Blowpipe wants to know what is the flux used by silversmiths for silver solder, and how to prepare and use it. It is borax, and the necessary conditions of successful soldering are perfect cleanliness and freedom from grease and all other impurities in everything used in connection therewith. The solder and the work to be soldered must be scraped clean, and the borax slate and pencil must be washed clean. Generally borax—lump borax, not powdered—is rubbed up with water until it is as thick as cream, or until it stands in ridges. The article it is rubbed up on is a piece of clean slate, 4 to 6 inches in diameter, and to roughen it it is sometimes scored across with the edge of a file. Make plenty while you are about it for the job in hand, and apply it to the work with a borax pencil (camel-hair brush), taking particular care to get all the surfaces that the solder is to run over covered with it. The next thing to do is to prime your work with solder, and for silver it would most probably be small pieces called "pallions" that we should use, and they would be picked up by the borax pencil and laid along the soldering seam. All you now have to do is to gently heat it to drive off the moisture, and then, if these "pallions" have not moved away, you can apply the full heat and make the solder run. Another way, after boraxing the soldering seam, is to have a narrow strip of solder and apply it to the work at about the time you think it will run, and as it runs you move it along until you get to the end of your soldering seam. Should there be too little borax on your work, you can pass a piece of the lump borax along it, and it will hold if the work is hot. This is in place of leaving the work to get cool previous to applying more with the pencil. The strip of solder spoken of above must be held in pliers or something of that sort. Borax is sometimes burnt and powdered before mixing with water, but that is only for cases where it is of great importance that the solder does not move. I hope this answers you. If it does not, then please write again.—H. S. G.

Fern Case and Fountain.—D. M. (*Larbert, N.B.*).—I presume you mean that you want a fountain for the inside of fern case. If so, you had better not have one of the self-acting kind, as it is hardly likely that your case—not having been designed for that purpose—would be suitable. An article appears in No. 31 which contains details of a very simple plan of fountain, which you can easily adapt to your requirements.—C. M. W.

Chiming Clock.—H. E. B. (*Liverpool*).—It is not possible to deal with this subject at present.

Home-Made Lathe.—H. E. B. (*Liverpool*).—Instructions for making lathes of a simple character are given in the papers entitled "Lathes for Everybody."

Advertisement Pages.—J. G.—I am obliged to you for the correction, which I have forwarded to the writer of the paper. I am glad to know that you find Work helpful. There is no necessity, I think, for me to repeat what I have already said so often about the pages that contain advertisements.

Building Society.—Plumber.—It is altogether beyond my province to say anything with respect to existing building societies. I may add, however, that I am unacquainted with the one about which you write. You have the rules, I presume, and can ascertain from them if you can withdraw the money that you have already paid in.

Glass Staining and Lead Light Work.—Plumber.—It is not possible to commence a series of papers on these subjects in Volume I.

Painting Carriage.—W. M. (*Islington*).—You have omitted naming your carriage in your query. The two prettiest colours I know of to go in combination with silvered work are lemon yellow and black—the body panels and under-carriage painted yellow picked out and fine lined black, or picked out lilac and fine lined black. The monogram, if any, to be in the following colours, blue, red, black, green, and brown. If we have the body and under-carriage black, we pick out with a shading yellow graduating from a tan brown at the top to a chrome yellow at the bottom. Get a tube colour of chrome yellow, raw sienna, and burnt sienna; the last two must be mixed with white or yellow and gold size. Instead of placing the colours upon each other we can place them in close proximity to each other, taking care that the yellow is quite dry, or the colours will run into each other. Get your strongest fine liner you have and line, leaving a space of ⅛ inch between. When dry get your raw sienna mixed with white, and line two lines within this space, these lines just touching the chrome lines. There will be a space left; this we fill up with tan colour made of burnt sienna and white mixed.

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This has a very stylish appearance when finished. This lining looks well upon a dark brown. The monogram should be in silver or gold shaded, the body fine lined yellow. The following would also look well, which I will give for the benefit of other readers:—Rich blue body panels, fine lined yellow. Under-carriage yellow, picked out black or blue, fine lined black. Green body panels, fine lined vermilion. Under-carriage vermilion, picked out black. Rich olive green body panels, fine lined lake-glazed vermilion. Under-carriage lake, picked out black, fine lined vermilion. Brown body panels and under-carriage in any shade, fine lined with white, orange or tan, picked out black. The mouldings of the body in all cases painted black. I shall be pleased to supply you with further information.—W. P.

Hand-Railing and Staircasing.—BRUTUS.—I will endeavour to meet your wishes on this point as soon as I can. I have some drawings from the workman of whom I spoke in the early numbers of WORK, but they are unaccompanied by descriptions, and he is now far away from London at work on a long job in the country. I must try to find someone else to write on the subject, but whoever may undertake it must not run in the old grooves. Readers seem to think that there is no trouble whatever to get good writers on special subjects. If they had had my experience, they would find it by no means as easy as they imagine, and would not wonder at the delays that frequently occur.—ED.

Brass Ball Making.—E. J. B. (*Blakenhall*).—By all means send me the article referred to on "Brass Ball Making" on approval.

Tinning Cast Iron Diameters.—TINNER (*Hull*).—Your testimony as to the value and utility of WORK is very gratifying. We are always pleased to hear that our efforts are appreciated by those for whom we write—viz., those who are willing to learn and anxious to improve their knowledge, not only of their own trades but of anything useful. To tin cast iron articles, they must first be pickled in a bath of mixed acid—hydrochloric acid 2 parts, sulphuric acid 1 part, water 7 parts. The stronger the pickle is made the quicker the articles will be ready. Heating the pickle also will cause it to act quicker. I used to use a large wooden tank lined with lead, and a steam pipe led to it from the boiler that drove the engine. When the things are sufficiently clean, rinse, and dip in a bath of "killed spirits" in which some lumps of sal-ammoniac have been dissolved. Pour this into the tinning bath, on which keep plenty of sal-ammoniac in a melting state. When tinned, take out and wipe or shake off the superfluous tin as required by the circumstances of the article. Cast iron is not so easy to tin as wrought iron, and some samples of iron are very difficult to tin at all. With regard to your second query—for a scale of circumferences for diameters of 1 in. to 24 in. I will tell you how to get the circumference of anything if the diameter is known. The rule is to multiply the diameter by 3·14569; thus an article 1 in. in diameter 1×3·14569 =3·14569. If this is too difficult for you to calculate for the sizes you require, here is a very simple plan, which gives results quite accurate enough for any ordinary work. Divide the diameter into 7 parts, and take 22 of these parts for the circumference; thus, supposing a piece of pipe 7 in. across, ⅐ of this is 1 in. multiplied by 22 = 22 in. When the diameter runs into odd measurements, it is perhaps best to work it out with a pair of dividers instead of an arithmetical calculation, as you would have to go into decimals to get accuracy. If you want these sizes for stove pipe and similar work, you must add sufficient to allow for the seaming, or if riveted for the lap.—L. L.

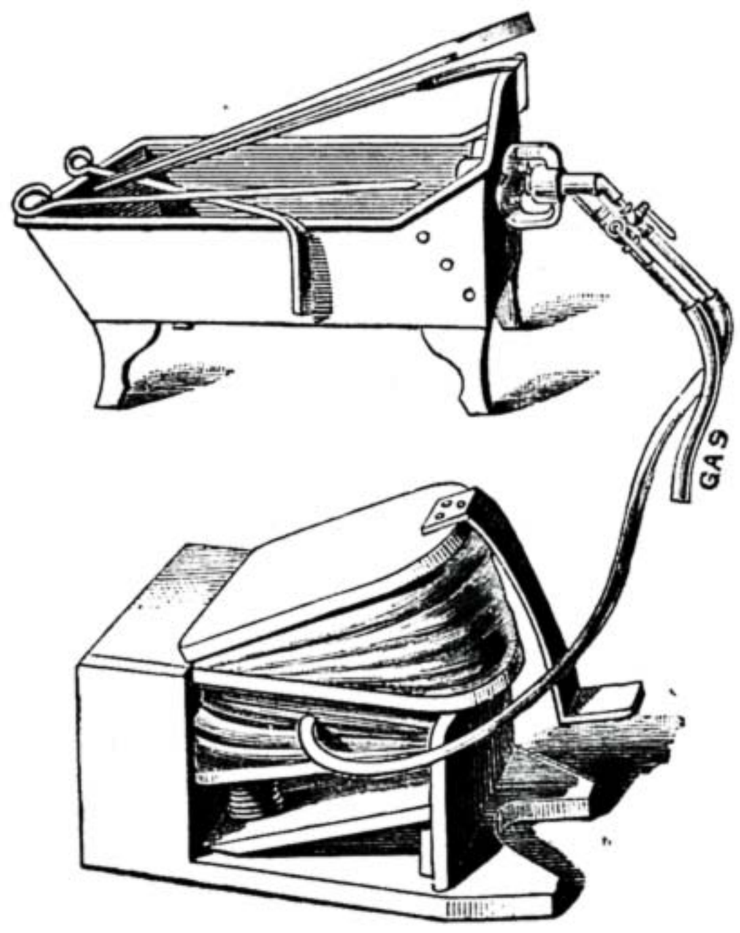
Duties of Telegraph Linesman.—W. W. (*Cupar*).—I do not know of a book detailing the duties of a telegraph linesman, and how to perform them. If any of our telegraphist friends know of such a book, will they kindly oblige us and W. W. by giving us the title, price, publisher's name, etc.?—G. E. B.

House Painting.—X. Y. Z. (*Liverpool*).—The following is a suitable book on house painting:—"House Painting," by Davidson, 5s., published by Lockwood & Co., Stationers' Hall Court, London.—F. J. C.

Drills.—C. E. (*Greenwich*).—Yes, you must soften the steel to form the drill, by heating it to a low red heat, and allowing it to cool gradually in air. When the drill is formed, and you want to temper it, proceed thus:—Heat it to a low red, and plunge the tip only in water. Withdraw it, and brighten the portion just immersed by rubbing a bit of soft stone upon it, and brush it quickly with a bit of waste. Now watch the changing colours imparted to the hardened point by the heat still remaining in the unhardened shank. When the point becomes of a plum colour, or dark purple, immerse it vertically in water until quite cold. I cannot see the reason of the method given in *Scientific American*, but turpentine is often used to assist the action of a drill through very hard substances.—J.

Sign-Writing Charges.—R. C. (*Chertsey*).—I am sorry to say I am unable to give R. C. any direct particulars as to the prices charged by sign-writers. Prices vary in almost all parts of the country, being highest in London, and other large towns; poor workmen also take work at a lower figure than their more skilled brethren would deign to accept, and the result of keen competition often leads to a lot of "cutting" in prices. R. C. may possibly, however, find this and other useful information in the following handbooks, which are published annually. Before purchasing these, though, I would advise him to write to the publishers, and ask if they contain prices of sign-writer's work. I know they contain prices of painters' and paperhangers' work, but am not sure as to sign-writing. (1) Lockwood's "Builders' and Contractors' Price Book for 1889" (3s. 6d.). (2) "Quantities and Measurements in Bricklayers', Masons', Plasterers', Plumbers,' Painters', Paperhangers', Gilders', Smiths', and Carpenters' Work" (1s. 6d.), Crosby Lockwood & Co., 7, Stationers' Hall Court, E.C. (3) Spon's "Builders' Price Book" (3s. 6d.), E. & F. Spon, 125, Strand, London. Perhaps, however, some reader of WORK would kindly give a price list for sign-writers based on London wages.—H. L. B. N.B. I will endeavour to include a price list in my articles if possible.

Coke Forge.—YOUNG APPRENTICE (*Kettering*).—I send you a sketch which will show you what you want: it is Fletcher's gas forge. You will see that a foot blower is necessary to work it; a bladder, as you suggest, would be of no use whatever, so don't waste valuable time experimenting with that. A fan would, perhaps, answer; but there is not the force and power in a fan that you would get from a foot blower, and these are recommended by the makers. The forge shown in sketch is a very useful article in a workshop for small odd forgings, doing



Coke Forge.

up lathe tools, etc. It is perfectly clean, no trouble in lighting, and is always ready for use. Starting all cold a slide rest tool can be repaired in about two minutes. The way to use it is as follows:—Fill the hearth with small coke, light the gas at the blowpipe, and use the blower. In a minute turn the gas out, and then turn on again, a very small quantity, not enough to burn at the blowpipe jet, but sufficient to visibly brighten the fire. When the heat is obtained the forge may be worked without the gas, but a little gas doubles the power. The gas must not burn at the blowpipe jet, except for the first minute. The parts may be had separately. Blower only, No. 590, £1 15s.; blowpipe, 10s. 6d.; hearth, 15s.; so what you do not succeed in making you will know the price of, and where to get it.—R. A.

Tin and Tinware.—NO NAME.—In speaking of tin as a metal, we do not mean the tin used for making up tinware. This is not tin at all, though it is often so named, but simply iron plates coated with tin. The pure metal tin is sold in blocks varying in weight from about 18 to 28 lb. This is called block or ingot tin. It is also sold in bundles of long strips; this is the kind termed grain tin. It is supposed to be better than the block tin, but I cannot say that I have noticed any difference; it is a convenient form for users of small quantities. Tin in the block or ingot gives a clear ringing sound like a bell when struck, and in strips can easily be recognised by a peculiar crackling sound when bent. Both tin and solders can be bought of any good ironmonger or coppersmith, value about 1s. per lb. retail. To melt, place it in an iron ladle or plumbers' metal pot; melt over a forge or kitchen fire, using a little resin as a flux.—L. L.

Electro-Gilding.—G. F. (*Birmingham*).—I hope shortly to be able to thoroughly deal with the subject of electro-gilding in an article in which I will endeavour to provide for your wants. The best solution for a novice or an amateur is one made up by the battery process, in which pure gold is dissolved in a solution of cyanide of potassium by the current from a strong battery.—G. E. B.

Model Yacht.—WHITE (*Shipley*).—I know of no book, inexpensive or otherwise, which deals with the class of model which you are building. A model merchant sailing vessel, for which you require instructions in rigging, is seldom made by the ordinary model yachtsman, it being almost an impossibility to sail such a model on anything like a definite course. If (as I presume it is) your model is only ornamental, and not intended for sailing, your best course will be to notice and copy the arrangement of the rigging of any specimen of naval architecture you may happen to see, and then to find a good picture or engraving of the type of vessel you wish to make a model of. You will find some excellent cuts of all classes of vessels in the numbers of *The Illustrated London News*. particularly in the old numbers of that paper, and you will then get a very good idea of what your model should be. As to the actual rigging, there is very little required beyond care and plenty of patience, and as you do not specify whether your model is a brig or a full-rigged ship or what not, I cannot without fuller particulars give you definite instructions as to the proportions of the masts, spars, etc., for which, if you require them, you must write again giving the necessary information. I may say, however, that the masts and spars should be of straight-grained yellow pine, the sails of fine calico, edged with cord, and the cordage, shrouds, etc., of the best water cord, or fishing line, of various thicknesses.—G. J. E.

Printing Book.—SARABAND (*Bridgwater*).—Printing is so universal a term, and embraces so many kindred arts, that I regret you did not define the particular kind of printing—*i.e*, letterpress, lithographic, copperplate, photographic, or process printing. The books on these arts are legion. You may, however, select from the following in the meantime, and address the editor again giving minute particulars, if my selection does not give you the precise information he requires: "Printing Machines and Machine Printing," 5s., Frederick J. F. Wilson; "Grammar of Lithography," 5s., W. D. Richmond; "Colour and Colour Printing as applied to Lithography," 5s., W. D. Richmond; "Zincography," 2s. 6d., Josef Bock.—J. W. H.

Tempering Tools—Long Chisels.—T. O. (*Liverpool*).—I answered this writer at your request fully, and sent it to you promptly with another question at the same time, I think. Briefly, be careful in forging to draw the steel regularly, not to smash the grain on one side, and work it unevenly. Steel-workers know there is science in the method of striking. It is explained in "Sword Making" in WORK. Also in letting it cool in the ashes after forging. Heating in a "muffle" is essential. Use an oil bath—that is, two inches of linseed or other oil floating on the top of the water. Put the chisel straight down through the oil into the water. Do not move it sideways at all, but draw it straight up out of the oil and water bath.—J. C. K.

Jet Warehouse.—G. H. (*Hetton-le-Hole*).—G. H. will be able to get all the jet he wants from the Whitby Jet Association, 17, Hatton Garden, London, E.C. It will be advisable to clearly specify the purpose it is wanted for, as I am given to understand that there are some six or seven different sorts.—H. S. G.

Egyptian Articles.—H. C. T. (*Newcastle-on-Tyne*) and T. E. P. (*Cambridge*) will find Cavendish House, Cheltenham, a depôt for Egyptian goods.—C. H. O.

Book on Violin Making.—C. D. A. (*Glasgow*).—A good book is "Violin Making," by Allen, 10s. 6d., published by Ward, Lock & Co.—F. J. C.

Sign Writing.—A NEW SUBSCRIBER (*Hackney*).—Papers on this subject have appeared in Nos. 1, 2, 4, 11, 13, 17, 19, 23, 30, 34, 39, 43, and 44 of WORK.

Spiral Spring.—BASIL.—I should advise you not to attempt to make the springs; it is work requiring special knowledge and training, and you will find it cheaper and more satisfactory to buy them. The size you mention should be made of steel.—F. C.

Casting and Moulding.—A. W. A. (*Aylestone*). The subject of clay modelling will be noticed in turn in a series to be commenced by-and-by on foundry work.—J.

Moulding Papier-Mâché.—H. C. C. (*Hornsey*) will find that his first letter was duly answered. Some little time must necessarily elapse before the reply to any query can appear in "Shop."—S. W.

Ticket-Writers' Ink.—R. H.—Ticket-writing ink is called japan ink, and may be obtained at any large stationer's cheaper than it can be made at home—viz., 6d. per bottle. The following formula, however, is simple:—Evaporate some of the water from the best black writing ink in a moderately heated oven, then add liquid gum arabic to replace the water lost in evaporation. This will dry with a gloss.—H. L. B.

Fret Saw.—H. B. (*Manningham*).—Without having full particulars of the stand you wish to utilise it is impossible to give such directions as would be of the slightest use to you. Even with them I am afraid you would find "the game not worth the candle," for fret machines are to be bought so cheaply that, by the time you had made the necessary alterations and additions, the expenditure would probably be more than if you had bought a machine. You may often pick up a second-hand one by advertising at a very low figure. An umbrella stand will be described in an illustrated article in due course. Directions for cleaning up wood for polishing will also be given. I think you will find that you may learn much from every page of WORK. As you say, the remarks on planing and planes are very interesting, but what is more to the purpose they are thoroughly practical and intelligible.—D. A.

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TABLE GIVING PROPORTIONS OF WHITWORTH SCREWS AND NUTS, WITH CHANGE WHEELS TO CUT THE SAME.

Diameter of Thread.	Threads per inch.	Wheels required for lead screw of ¼-in. pitch.				Diameter at bottom of thread.	Sectional area at bottom of thread.	Hexagon nuts.	
		Mandrel.	Driven.	Driver.	Lead Screw.			Across flats.	Across angles.
1/16 = ·0625	80	20	100	30	120				
3/32 = ·09375	60	20	100	40	120				
1/8 = ·125	40	20	100	60	120			·338	
5/32 = ·15625	32	20	80	60	120				
3/16 = ·1875	24	20			120	·136	·015	·448	·517
7/32 = ·21875	24	20			120				
1/4 = ·25	20	20			100	·186	·027	·525	·606
5/16 = ·3125	18	20			90	·241	·046	·6014	·694
3/8 = ·375	16	20			80	·295	·068	·7094	·819
7/16 = ·4375	14	20			70	·347	·094	·8204	·947
1/2 = ·5	12	20			60	·394	·121	·9191	1·016
9/16 = ·5625	11	20			55	·456	·163	1·011	1·167
5/8 = ·625	11	20			55	·509	·203	1·101	1·277
11/16 = ·6875	10	20			50	·571	·256	1·2011	1·3869
3/4 = ·75	10	20			50	·622	·304	1·3012	1·502
13/16 = ·8125	9	20			45	·684	·376	1·39	1 605
7/8 = ·875	9	20			45	·733	·422	1·4788	1·707
15/16 = ·9375	8	20			40	·795	·496	1·5594	1·8
1 = 1·	8	20			40	·84	·554	1·6701	1·928
1 1/8 = 1·125	7	20			35	·942	·694	1·8605	2·148
1 1/4 = 1·25	7	20			35	1·667	·894	2·0483	2·365
1 3/8 = 1·375	6	20			30	1·161	1·06	2·2146	2·557
1 1/2 = 1·5	6	20			30	1·287	1·3	2·4134	2·786
1 5/8 = 1·625	5	20			25	1·369	1·472	2·5763	2·974
1 3/4 = 1·75	5	20			25	1·494	1·753	2·7578	3·184
1 7/8 = 1·875	4½	40			45	1·59	1·985	3·0183	3·485
2 = 2·	4½	40			45	1·716	2·31	3·1491	3·636

Any intermediate idle wheel.

Change Wheels.—F. W. H.—You describe the wheels of the two lathes you use, with the intention of asking "two questions," but you conclude without asking any question at all. As I am not a thought reader I can only guess what you may want to know. Here, then, is a list of useful pitches taken from a table of Whitworth bolts, and including gas theads :—40, 32, 28, 24, 20, 18, 16, 14, 12, 11, 10, 9, 8, 7, 6, 5, 4½ threads per inch ; 28 is "brass gas," 14 and 11 "iron gas." Probably you will want no others than these. Now for your first lathe, which has a screw of 2 threads, and 13 wheels of 16, 20, 22, 32, 36, 40, 40, 44, 48, 56, 64, 72, 80. Put the 16 wheel on the mandrel, and try each of the larger wheels on the screw, thus :—$\frac{16}{80}=\frac{1}{5}$, but as the lead screw has a pitch of ½ we get by this arrangement a pitch of $\frac{1}{10}$, or ten threads per inch. This is the finest pitch the wheels will cut when arranged in single train. Trying other wheels on the screw we get—$\frac{16}{72\times2}=9$ threads, $\frac{16}{64\times2}=8$ threads, $\frac{16}{56\times2}=7$ threads, $\frac{16}{48\times2}=6$ threads. You see why the numbers 80, 72, 64, 56, 48 were chosen; the 16 becomes 8 when divided by the 2-pitch screw, and the numbers of the wheels are multiples of 8, so that they give 10, 9, 8, 7, 6 threads exactly, as required by the Whitworth rates. Continuing our investigation, $\frac{16}{44\times2}$ gives 5½, $\frac{16}{40\times2}$ gives 5, $\frac{16}{36\times2}$ gives 4½, and $\frac{16}{32\times2}$ gives 4 threads per inch.

We need go no further in that direction, but only notice that the number of teeth in this part of the series rises by 4 instead of by 8, enabling us to get 5½ and 4½ threads per inch. However, thus far we have all the required rates from 4½ to 10, and the remainder we must seek for by means of the compound train. Having already obtained 10, 9, 8, 7, 6, 5, 4½ threads as before explained, it will be understood that if we put on the intermediate stud a pair of wheels which are as 1 to 2, say the 22 and 44, or 32 and 64, we can reduce the speed of the lead screw by one-half, and so multiply by 2 the pitch of the screw we shall cut. Now multiplying 6, 7, 8, 9, and 10 by 2 gives us 12, 14, 16, 18, 20 threads; by putting on intermediate wheels of 3 to 1, we might get 24 threads from 8 ; and by intermediate wheels of 4 to 1, from 7, 8, 10, we get 28, 32, 40 threads. The 16 and 48 wheels are the only ones which are as 1 to 3, therefore, as we have only one 16 wheel we must put for 16 and 64 to give 8, 20 and 80, so as to leave the 16 and 48 wheels free for the intermediate stud ; 16 and 64 bear the same relation to each other as do 20 and 80. In placing the pair on the intermediate stud we must, of course, put them on so as to reduce the motion, the larger going on first to be driven from the mandrel, and the smaller next to drive the wheel on the screw. Looking over our list of pitches, we shall see we have obtained them all but 11 threads, quite an important one, since it is not only the rate of Whitworth bolts of $\frac{9}{16}$ in. and ¾ in., but it is also the rate used on iron pipes of 1-in. bore and over. Now we obtained 5½, and, though that rate is not in the table, by doubling it we shall obtain the wished-for 11. Your second lathe has also the ½-pitch lead screw, but it has, apparently, the usual set of 22 wheels rising by 5 from 20 to 120; you say, however, that the 35 wheel is "fixed" on the mandrel ; I don't think so, but if it is, I would have it off somehow, if it had to be turned off, and put instead the 20 wheel, which is most often wanted with a 2-threaded screw.—F. A. M.

IV.—QUESTIONS ANSWERED BY CORRESPONDENTS.

Safety Cages.—T. J. (*Dudley*) writes in reply to E. J. J. (*Notting Hill*) (see page 590) :—"I shall be pleased to put before E. J. J. a new safety apparatus for mine and other cages, which for simplicity and certainty of action I claim to be the very best yet introduced."

Ink Bottles.—J. W. W. (*Hanley*) writes in reply to INQUIRER (see page 526) :—"No doubt you can get the article you require if in store by applying to Calvert & Lovatt, Langley Mills, Nottingham."

Birdcage Fronts.—J. G. (*Nottingham*) writes :—"I beg to say if J. S. (*Coatbridge*) (see page 587) will communicate with me I will make him what fronts he wants, or I will put him in the best way to proceed in making them himself if agreed."

Tarring Fence.—W. D. (*Newcastle-on-Tyne*) writes in reply to C. M. (*Hornsey Park Road*) (see page 654) :—"Coal tar is as good as any for this purpose. It should be mixed with pitch, boiled, and applied hot. It will dry hard and very glossy. If mixed with mineral naphtha it will soak into the wood and dry a dull black. The tar washing off by the rain may have been caused by the fencing being wet when it was applied."

Tarring Fence.—W. E. H. (*Bognor, Sussex*) writes in answer to C. M. (*Hornsey Park Road*) (see No. 41 of WORK) *re* tarring fence :—"He will find that to follow the plan adopted here by the fishermen in tarring their boats will be the best. They obtain the tar from the gas-house here, and add a pint of turpentine to the gallon of tar or more if required to make it thin enough. Then choose a warm sunny day, the wood being perfectly dry, and lay it on with an ordinary tar brush. Some add naphtha instead of turps on account of cheapness, but turps is best to add as it lasts longest. Once a year will be found sufficient for a fence. If new work, give two coats of tar, one week to elapse between each coat."

Tarring Fence.—FAL writes in reply to C. M. (*Hornsey Park Road*) (No 41, page 654):—"Black varnish, which is specially prepared for outdoor work, is much better for C. M.'s purpose than tar. Messrs. Bayliss, Jones, and Bayliss, Wolverhampton, make a very good quality at 1s. 6d. per gallon. Brushes, 1s. each. There are numerous other makers."

Wheels.—WHEELER writes in reply to R. B. (*Largoward*) :—"In answer to your inquiry where you can buy machine-dressed materials for wheels, if you will write to any of the three makers named below you will receive a price list or a quotation for any requirements. The following names have been selected from a number of dealers in the same articles : William Cary, Red Bank, Manchester; James Chapman, 181, Chapel Street, Salford, Manchester ; Joseph Owen & Sons, 21, Grosvenor Street, Manchester, and 67, St. Anne Street, Liverpool. You will be able to get what you want, even to the ready-made wheels ready for hooping and bushing, at Cary's."

Electric Motor.—B. F. (*Birkenhead*) writes in reply to J. C. (*Shipton, Yorks*) :—"There is one of these working often in Avonberg's window, Manchester Street, Liverpool, driving the way you want. I have seen and bought the wheel of life with pictures for 6d. I have seen in Archer's, optician, Lord Street, electric motor with driving wheel on for 2s. 6d."

Trade Note.

ONE hundred and four societies reported to the request of the Board of Trade for returns, and these represented a total membership of 373,904, which Mr. Burnett considers are more than one-half the trade unionists of the whole kingdom.

WORK

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Beit's Patent Enamelled Adhesive Water-Proof Advertising Paper Letters and Figures in all Colours and Sizes.—Sole and Original Manufactory, 17, Arthur Street, New Oxford Street, W.C. Agents apply. Sample sheet gratis. [6 R

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Notice.—We take in Exchange Lathes and various tools for better. Catalogue, 6 stamps. List of Second-hand, 2d.—Britannia Co., Colchester.

Largest Stock of Engineers' and Mechanics' Lathes, Shapers, etc. Stocks and Dies. Forges, etc.—Britannia Co., 100, Houndsditch, London.

Call and select from our stock at 100, Houndsditch; but all letters addressed Britannia Tool Factory, Colchester.

Britannia Co. supply Gas or Steam Engines, and fit up workshops complete. Terms, Cash or easy terms. [13 R

Patent Unbreakable Twist Bit.—¼ in., 1s. 6d.; ⅜ in., 1s. 8d. ; ½ in., 1s. 9d. ; 1 in., 2s. 2d. ; 1¼ in., 2s. 10d. ; post free 2d. extra.—HOBDAY, Chatham.

Warranted Saws.—Panel, 3s. 9d. ; hand, 4s. ; half-rip, 4s. 3d. Exchanged if faulty. Post free, 6d. extra.—HOBDAY, Chatham.

Special Quality Saws.—Warranted to cut 1 in. square iron. Panel, 6s. ; hand, 6s. 6d. ; half-rip, 7s.—HOBDAY, Chatham.

Odd Jobs Tool.—Comprising Try, Tee, and Mitre Square, Marking, Mortise, and Depth Gauge, Spirit Level, and Plumb, Compass, &c. 3s. 9d.—HOBDAY, Chatham. [14 R

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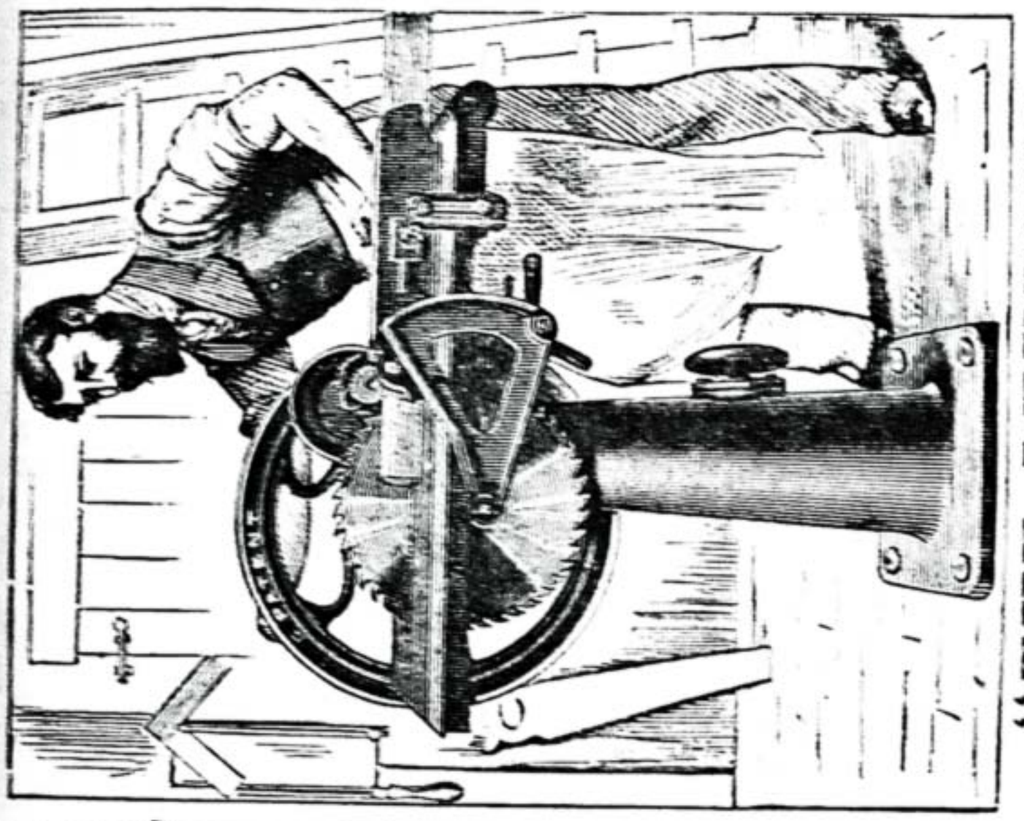

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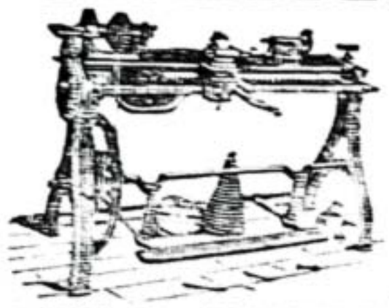

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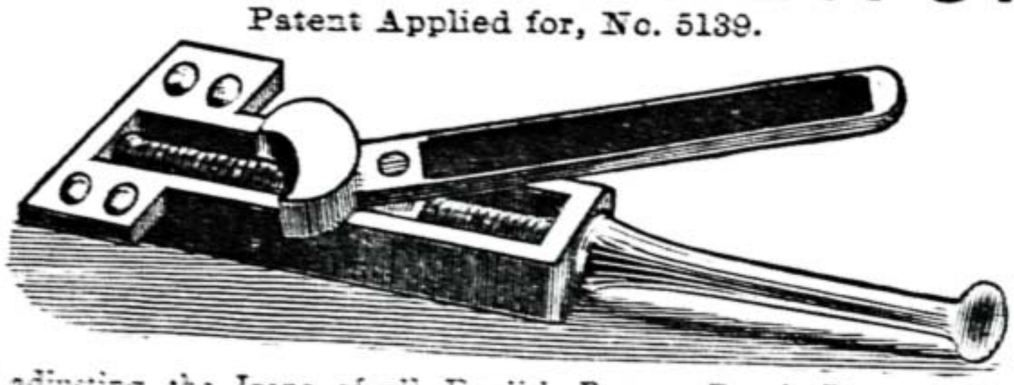

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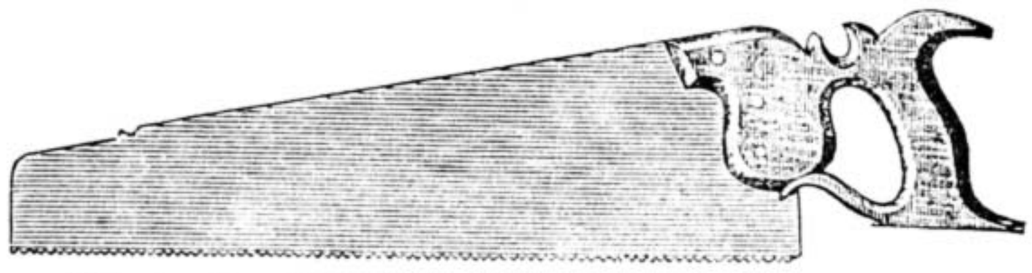

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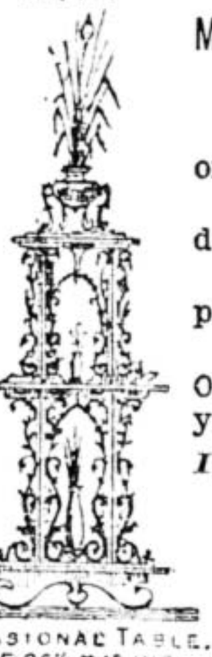

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